AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

Publication Office, St. Joseph, Michigan. Headquarters of the Society, Station A, Ames, Iowa.

Published monthly by the Society. Subscription price to non- members of the Society, $3.00 a year, 30 cents a copy; to members of the Society, $2.00 a year, 20 cents a copy. Postage to Canada, 50 cents additional; to foreign countries, $1.00 additional.

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Vol. II MARCH, 1921 No. 3

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Volume 2 MARCH, 1921 Number 3

The Design of Farm Elevators

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THE object of this report is to present information on the following points with reference to the design of farm elevators:

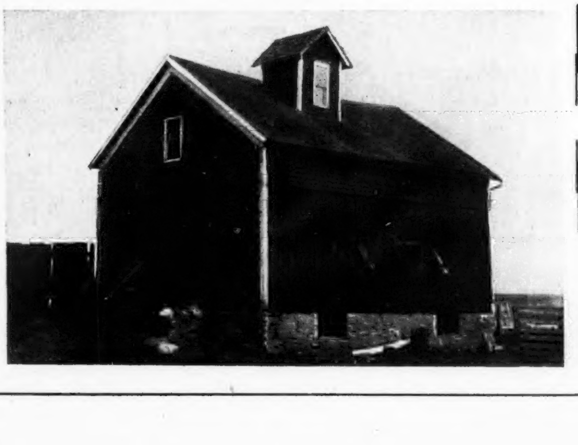
1. Some of the different types of buildings that have proven practical for storing ear corn and small grains.
2. The maximum depth and thickness ear corn may be piled without danger of spoiling under average conditions.
3. The percentage of air spaces or openings in corn crib walls.
4. The pressures exerted by ear corn and the small grains in confinement.
5. Methods of building out rodents.
6. Floor construction in cribs and granaries.
7. The various types of shelling trenches.
8. Schemes for ventilating cribs.
9. The usual precautions for preventing rain or snow from blowing into crib.
10. Location of the farm elevator.
11. Ways of drying out corn in crib.

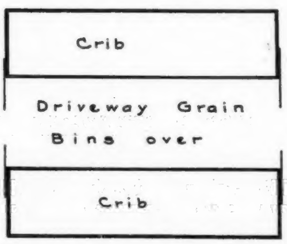
The modern farm crib and granary is generally referred to as a farm elevator. The modern farm elevator is of comparatively recent design. Its development has been evolutionary in character and the various stages in its progress are marked by corresponding development in the methods of handling corn and grain. In the early days when grains were shovelled by hand from wagons the height of the bin or crib was naturally limited to the height a man could conveniently shovel. The old pioneer type of crib usually consisted of a simple shed roof structure standing by itself in some exposed position. When more storage room was required another crib was built alongside it with enough space between the two for a driveway and both were covered with the same roof. This driveway furnished the man who was unloading corn protection from the winds and storm which, in many cases, was badly needed as the farmer was often compelled to shovel off his load by lantern light after the evening chores were done and the evening meal was over. This sheltered driveway also provided a convenient place for housing vehicles and farm implements. With the advent of power-driven conveyors there occurred a radical change in the design of cribs and granaries. The height was no longer controlled by the height to which a man could shovel, therefore, cribs were built higher to obtain greater economy in construction. Bins for grain and cribs for corn were included under one roof so that one conveying system would serve to handle all of the farm grains, effecting further economy in construction.

Probably the most common plan for a farm elevator consists of a double crib with driveway between and with bins for small grain over the driveway. In the driveway is located the dump or pit and the legs and conveyors for elevating the corn and grain. The cribs are rectangular, semi-circular, or circular in form. Quite a number of types of farm elevators of different plans have been perfected. These include the following:

1. A circular structure with a crib for corn in the lower section and with storage for grain in the upper part.
2. A rectangular structure with two driveways and three cribs. (Fig. 2.) By this arrangement more corn and grain

Report of the farm structures committee presented at the fourteenth annual meeting of the American Society of Agricultural Engineers held at Chicago, December 28 to 30, 1920.





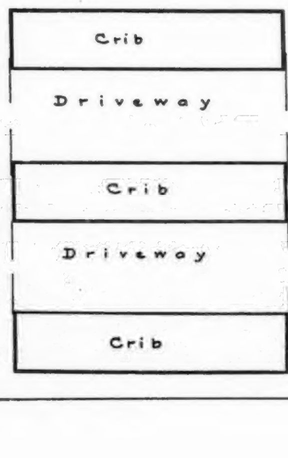


Fig. 1, at top and left. Plan and photograph of a common type of farm elevator

Fig. 2, right. Design giving greater capacity per unit

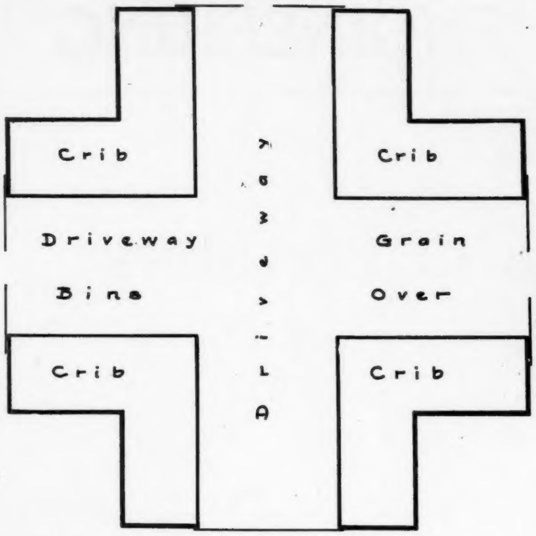


Fig. 3. Plan and photograph of a cross-shaped farm elevator having two driveways intersecting at right angles. The driveways occupy an excessive amount of space in proportion to storage capacity

can be handled by one conveyor system.

3. A cross-shaped structure with two driveways at right angles to each other. (Fig. 3.) This type of crib has little to commend it.

The circular form is especially suited to masonry structures as this shape makes it easy to reinforce. There is also an economy of materials as a circular structure will enclose a greater volume for a given amount of wall-space than any other form. Circular storages are used singly, in twos, or in groups or batteries.

A modern frame farm elevator is shown in section in Fig. 4. This section shows a crib 30 feet wide made up of double crib 8 feet 6 inches wide with a 13-foot driveway. A grain bin which may be made 14 feet deep (for oats) is placed over the driveway. The floor of this bin is partly supported by ¾-inch rods, spaced 4 feet apart, which runs to plate height at the sides of the bin. Studdings are two-by-six's spaced 16 inches on center. The bin walls are stiffened by tying across with two-by-ten's at plate line. The bin may be partitioned and made into smaller bins or room for grinder as desired.

The gable ends of this structure are strengthened by tying with a plate made of one 2x6-inch and one 2x12-inch member. The studding from lintel over door or floor are 2x6 inches with two of these replaced by two-by-ten's. These two-by-ten's are spaced two studding spaces, or 2 feet 8 inches on each side of center. Two-by-four studding 16 inches on center are used above the plate.

The crib bins are 8 feet 6 inches wide with 2x6-inch studding 16 feet long. The side walls are tied together by means of 1x10-inch diagonal bracing spaced 4 feet on center placed about seven feet above floor which allows head room under.

Shelling trenches are shown which serve for sheller drag or a means of ventilating when necessary to dry soft corn. Ventilating flues are made next to the small grain bin by placing cribbing boards or lathe on crib side of studding.

One of the most recent developments in the masonry farm elevator is a structure made of concrete staves. (Fig. 5.) Staves used for this purpose are similar to those used in the erection of silos with the exception that each is provided with two openings for ventilation. These openings are each 4 inches wide and 9 inches long and have four ¼-inch rods embedded in the concrete in such a manner that they pass through both openings forming a grating for excluding ro-

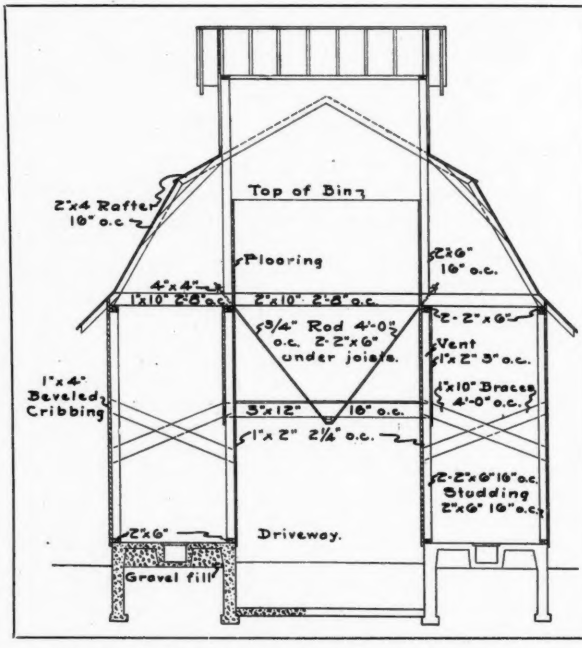


Fig. 4. Section of a modern frame farm elevator with double crib and grain bins over driveway

dents. The staves are 2½ inches thick, 30 inches long, and 10 inches wide. The cribs of this installation are semi-circular in plan, making this structure oblong in shape. Its dimensions are 20 feet by 30 feet 10 inches. A driveway 10 feet 8 inches wide runs through the center. Storage bins for grain are provided over the driveway. A bucket elevator conveys corn and grain to the cupola from whence it is distributed in the bin desired.

Steel hoops similar to those used on silos serve as reinforcement. The ends of the hoops are rigidly secured to the heavy reinforced concrete door jambs up to the top of the driveway doors. Above this point the rods are carried continuously around the structure. As the lateral pressure of small grain is greater than that of ear corn, additional rein-

forcement for the bins was provided in the form of steel channels and "I" beams. These are shown directly over the doorway in the illustration.

A five-pound channel on the outside wall is bolted to an "I" beam on the inside. Three such pairs are located on each bin wall over the driveway doors. As a further precaution against possible spreading, the channels on opposite sides of the structure are tied together with steel rods. The channels are also bolted firmly to the corner studs of the grain bin walls.

It was found on observing the width of cribs that the thickness of corn in the crib varied for different communities. It ranges from 5 feet to 9 feet 6 inches or over in width. In the eastern part of the Middle West, where smaller crib capacity is required, the width varies from 5 feet to 7 feet 6 inches, while the greater width is found in the corn belt. This greater width is satisfactory in a normal year. It is unsatisfactory, however, for soft corn and artificial heat or other means must be used to dry the corn.

The openings in crib walls vary from 10 to 50 per cent or more. The old cribs built with outside covering with 1x10-inch or 1x12-inch vertical siding allowed very little air from the outside. In no case would the cracks between boards exceed ¼ inch. The driveway side of these cribs was enclosed by 1x2-inch or 1x3-inch strips spaced not over ⅜ inch apart. This spacing was usually about ¼ inch, or about 10 per cent.

The modern double cribs of the Middle West are enclosed with bevel cribbing usually 1x4-inch stock. This cribbing, with about 3¼-inch face, is spaced ¼ to 1 inch apart. Closer spacing of ½ to ⅝ inch may be made which will discourage rats. This would slightly reduce the percentage of openings but still give a greater percentage than found in the older cribs. In masonry cribs the amount of air space varies from 20 to 50 per cent of the wall area. In general, it is well to provide at least 20 per cent openings under average conditions.

Only a limited amount of data is available on the pressure of ear corn. A thesis "Lateral Pressures on Corn Crib" conducted by two senior students, V. W. McClung and Harry Hall, of the agricultural-engineering department at the Iowa State College, in 1916, gave as conclusions:

(1) "Ear corn represents more of a solid than a fluid or semi-fluid."

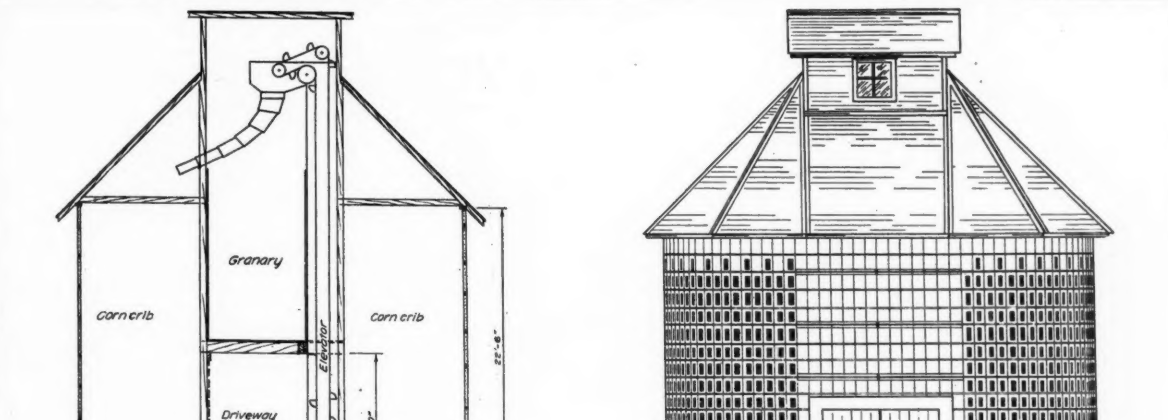


Fig. 5. A concrete stave farm elevator with semi-circular cribs and bins for small grain over driveway

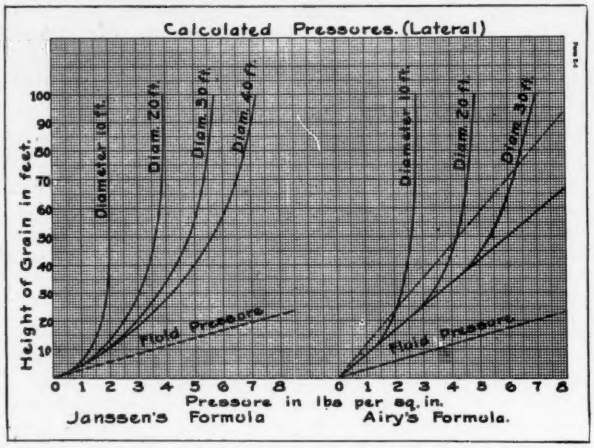


Fig. 6. Graphs of Janssen's and Airy's formulae

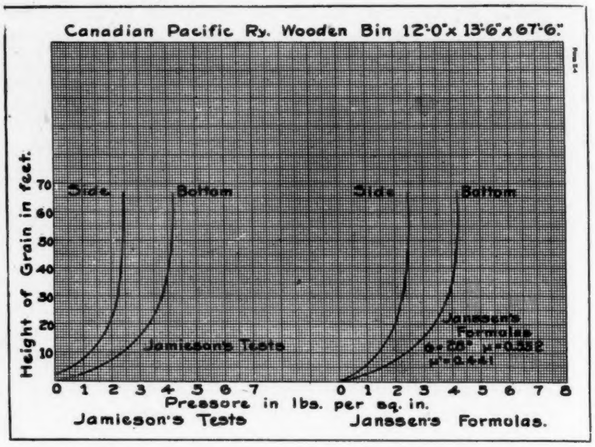


Fig. 7. Comparison of formula with test results

(2) "Lateral pressure is about one-fifth of vertical pressure downward."

(3) "Corn tends to wedge together and hold it perpendicular, sort of locking rather than flowing as wheat or the smaller grains."

The crib on which observations were made was a lath stave fencing crib, 8 feet in diameter and 8 feet high.

It is doubtful if pressure due to ear corn in confinement exceeds 10 pounds per square foot per foot of depth. Cribs designed on this basis have not shown any indications of failure.

Several formulas have been developed for calculating the pressure in grain bins: (1) Janssen's Solution and (2) Airy's Solution. The results of these two methods agree very closely with experiments.

Since these formulas are lengthy and involve considerable calculation, they will be illustrated by graphs. The graphs of the two formulas—Janssen's and Airy's—are shown in Fig. 6 for lateral pressure for wheat. These agree closely in shape, the Janssen's formula pressures being less than those from Airy's calculations.

Some experiments have been conducted to verify these calculations. One conducted by J. A. Jamieson in 1900 on a full size bin in an elevator on the Canadian Pacific Railway, West St. John, North Dakota, is shown in the graph on the left in Fig. 7. The bin was of timber crib construction, 12 feet by 13 feet 6 inches in size and 67 feet 6 inches high. Manitoba wheat weighing 49.4 pounds per cubic foot was used. The calculated pressures from Janssen's formulas are shown on the right in the same figure. It is to be noted that the curves are identical in shape and are close in value.

The results of another test made on a bin while filling by Prof. Henry T. Bovey, McGill University, Montreal, in 1901 are shown by graphs in Fig. 8. This bin was of wood construction, 12 by 14 feet in size. The height above centers of diaphragms on which pressures were determined was 44 feet 10 inches.

A set of graphs showing the percentage of wheat carried by bin wall and floor is shown in Fig. 9. These graphs are the result of Jamieson's tests on a model wooden bin 12 feet by 12 feet by 6 feet 6 inches for wheat weighing 50 pounds per cubic foot.

Jamieson in further tests found that corn weighing 56 pounds per cubic foot will give approximately the same pressure as wheat. Peas weighing 50 pounds per cubic foot will give approximately 20 per cent greater pressure than wheat, while flaxseed weighing 41.5 pounds per cubic foot will give 10 to 12 per cent greater pressure than wheat.

Since a cubic foot of wheat is heavier than the other grains, except peas, a bin designed for wheat will safely carry all loads for shelled corn, and oats which are lighter. In designing bins for peas or beans add 20 per cent for strength of bin walls, and for flaxseed add 12 per cent.

The weights of a cubic foot of loosely filled grains in measures are as follows:

	Pounds
Wheat	49
Barley	39
Oats	28
Corn	44
Beans	46
Peas	50
Flaxseed	41
Tares	49

It is believed that all farm elevators which are designed with grain bins for the light-weight grains should have a safety line prominently painted on the inside of the bin and continuous around the wall for either wheat or shelled corn.

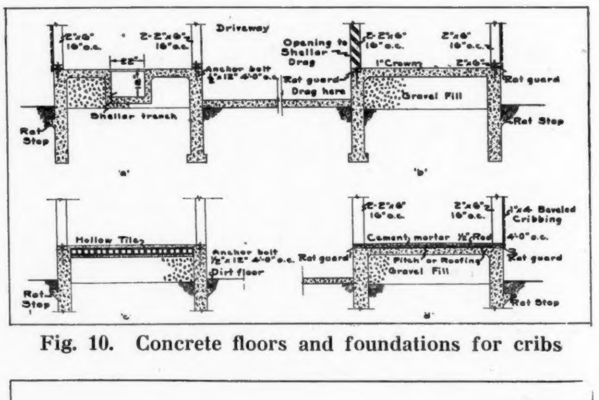
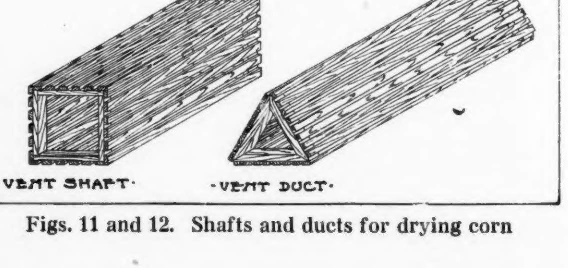


Fig. 10. Concrete floors and foundations for cribs



Figs. 11 and 12. Shafts and ducts for drying corn

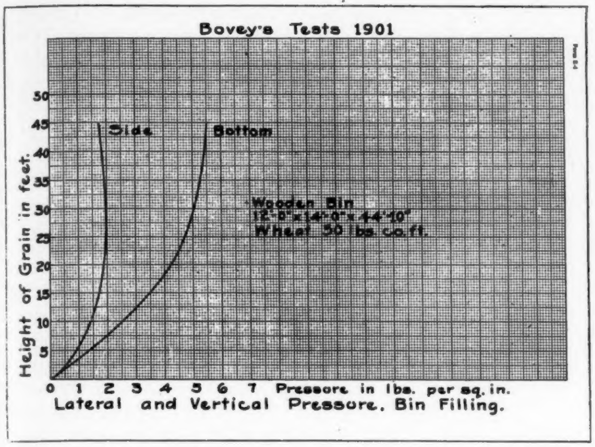


Fig. 8. Tests made as bin was being filled with wheat

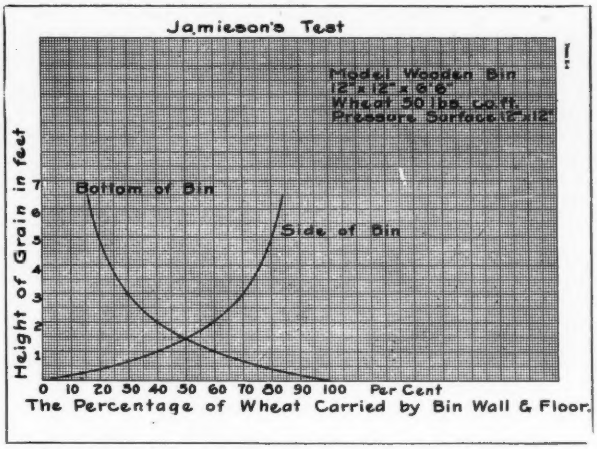


Fig. 9. Load carried by bottom and wall of wheat bin

A careful observance of this would prevent a large number of bin failures.

The following conclusions were drawn from the experiments mentioned in this section and others:

1. The pressure of grain on bin walls and bottoms follows a law (which for convenience will be called the law of "semi-fluids") which is entirely different from the law of the pressure of fluids.

2. The lateral pressure of grain on bin walls is less than the vertical pressure (0.3 to 0.6 of the vertical pressure, depending on the grain, etc.), and increases very little after a depth of 2½ to 3 times the width or diameter of the bin is reached.

3. The ratio of lateral to vertical pressures, k, is not a constant, but varies with different grains and bins. The value of k can only be determined by experiment.

4. The pressure of moving grain is very slightly greater than the pressure of grain at rest, maximum variation for ordinary conditions being probably 10 per cent.

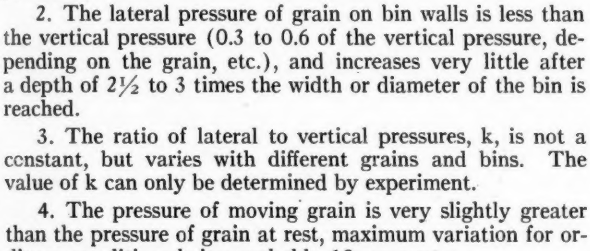


Fig. 13. Rack under roof for first drying of corn

5. Discharge gates in bins should be located at or near the center of the bin.

6. If the discharge gates are located in the sides of the bins, the lateral pressure due to moving grain is decreased near the discharge gate and is materially increased on the side opposite the gate. (For common conditions this increased pressure may be two or four times the lateral pressure of grain at rest.)

7. Tie rods decrease the flow but do not materially affect the pressure.

8. The maximum lateral pressures occur immediately after filling and are slightly greater in a bin filled rapidly than in a bin filled slowly. Maximum lateral pressures occur in deep bins during filling.

9. The calculated pressures by either Janssen's or Airy's formulas agree very closely with actual pressures.

10. The unit pressures determined on small surfaces agree very closely with unit pressures on large surfaces.

11. Grain bins designed by the fluid theory are in many cases unsafe as no provision is made for the side walls to carry the weight of the grain, and the walls are crippled.

12. Calculation of the strength of wooden bins that have been in successful operation shows that the fluid theory is untenable, while steel bins designed according to the fluid theory have failed by crippling the side plates.

The information of this section (pressure of small grains) was secured from the book, "Design of Walls, Bins and Grain Elevators," by Milo S. Ketchum, second edition 1913.

The rodent menace costs the farmers and grain men in the United States millions of dollars each year. It has been estimated that each rat destroys from $2.00 to $4.00 worth of grain in a year and the rat population is assumed to be at least equal in numbers to the human population. This waste may be reduced by discouraging and building out these pests. This may be accomplished by using concrete for foundation walls and floors and placing the floor some distance—18 to 24 inches—above grade. Modern construction and the shelling trench have encouraged this height of floor above grade. This makes it more difficult for rodents to enter a crib because they must climb or jump up to enter.

Rat guards may be used to stop rodents from climbing. These are shown in Fig. 10 "b" and "d." A piece of galvanized sheet metal is set under the wall plate and extends outward and downward for three or four inches.

A further precaution against rats burrowing is made by extending a step footing or building a ledge of concrete 4 to 6 inches outward from the foundation wall. A rat in burrowing will become discouraged and give up when meeting an obstruction of this kind. (Fig. 10.)

The shelling trench should be screened with heavy hardware wire cloth which should be placed on a hinged frame that closely fits the opening. This door may be opened for access of cats or ferrets.

In the cement stave type of crib rats are kept out by the 1/4-inch rods which run lengthwise through the openings. Some concrete block cribs have wire mesh embedded in the concrete which effectively prevents rats and mice from crawling in through the openings provided for ventilation.

While wood has been used for crib floors it is not permanent and will not stop rodents. The more permanent floor made from concrete is advised. This may be made with sheller trench as shown in "a," Fig. 10, or of solid concrete with fill under or a combination tile and concrete fill.

The floor construction for small overhead grain bins is made by using matched flooring over joists as shown in section Fig. 4.

The shelling trench may be made either as shown in "a" or "b" Fig. 10. The former consists of a rectangular or square trench extending from end to end of crib. It is large enough to receive the sheller drag. The depth is usually 18 inches with a width of 20 to 24 inches. The disadvantages are the difficulty in placing the drag in the trench and the harbor made for rats if not thoroughly guarded. A large part of the corn will fall directly into the trench. It also serves as a ventilating duct.

The provision for a drag along the inside of the crib as shown in "b" Fig. 10 is extensively used for shelling. The boards are removed from the outside. The drag may be moved from one crib to the other without resetting sheller. Furthermore, it may be used for removing ear corn for feeding purposes.

Its disadvantage is the difficulty of making it rat proof. Rats will climb up on vehicles or implements and jump to these openings.

For ventilating corn cribs the cupola or aerators placed on the roof will allow the air to pass out from cribs and bins. The air will rise upward through the grain to replace the air removed.

Louvre windows may be placed in gables of cupola or gables of crib for air circulation. These should be screened on outside with small mesh hardware cloth to keep out sparrows.

Additional ventilation may be secured by utilizing the sheller trench for an air passage and placing vent shafts (Fig. 11) over this at intervals. The natural draft or a forced draft and heat may be used. Another means of allowing air to circulate through the mass of corn is placing vent ducts (Fig. 12) across the crib. These ducts are made the width of the crib and they are placed horizontally across through the corn. This opens the interior of the crib to air circulation.

Under ordinary conditions rain and snow will not enter a well-built crib. It is advisable, however, to provide a slight crown in the floor for any moisture accumulating from rain, snow or soft corn to flow out. Provision is made in "a" Fig. 10 by raising plates by shimming up with slate or pieces of hollow block. This allows moisture to pass out and at the same time protects the plate from decay or fungus growth.

In "b" Fig. 10 the inside is set in or partially embedded in the concrete floor. The plate should be treated with creosote as a protection. The outside plate is shimmed up with slate or tile.

In states where blizzards are prevalent the top 2 or 3 feet of the crib is made tight so that snow will not blow on the corn after it settles.

A method recently adopted of placing a drying rack under the roof by a materials company has merit and should be recognized. This consists of a grating (Fig. 13) built between roof and small grain bins. The corn is allowed to remain on grating for several days which serves as a dryer. The heat from the roof and air passing up through rack will remove considerable moisture before corn is finally dropped into bins. This permits the corn to dry on the rack from a few days to a week before the corn is dropped to bins below. Another claim is the corn may be gathered a week to ten days earlier by using this dryer.

Training the Agricultural Engineer

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HERE in the South one cannot help but be impressed with the great field of usefulness for the agricultural engineer. Farm planning, terracing, drainage, equipping, construction organization and management call for the services of trained agricultural engineers. It speaks volumes for her climate and soils that the South has secured such great wealth from her partially developed agriculture, that it gives one an inkling of the wonderful permanent agricultural industry that will result from the practical application of business and engineering methods. The point which I wish to emphasize is that to be a real vital factor in the upholding of the South, the agricultural engineer must be not only technically correct in his work, but he must have the commercial point of view. Please understand "commercial" in its best sense, that of always looking at agricultural problems from their dollars-and-cents standpoint. We have reached a stage in our agriculture where food and clothing must be produced economically so that the consumer may be able to secure them at a moderate cost. This necessitates efficient planning and management, which will not be forthcoming unless agricultural enterprises are placed on a strictly profit-producing basis.

Hence the question may be fairly asked, "Has the average agricultural engineer had sufficient business training to enable him to render the most practical service?" I believe that we must answer that question in the negative. This leads me to propose that this Society endeavor to promote the training of agricultural engineers so that they may have more of the commercial viewpoint. It is suggested that this may be accomplished to some extent by the following means:

1. Give the instruction in the agricultural colleges more along dollars-and-cents lines, preparing the courses with this in view and instiling the business viewpoint into the student from the very start.

2. This will necessitate the paying of higher salaries, so that instructors who have had wider practical experience may be employed.

3. As a regular part of the course provide series of lectures by successful farm operators, agricultural engineers and county agents.

4. Require more field work of students, arranging to place them during the summers on well-managed farms and plantations.

5. Cooperation between the teaching staff, agricultural engineers and the county agents should permit frequent field visits to profit-making farming enterprises.

6. Arrange so that new graduates may secure minor positions with accredited concerns engaged in commercial farming.

Should we not impress it on the agricultural colleges that their recent graduates are rarely fit for engineering or managerial work where the expenditure of large sums of money is involved? Surely we are all familiar with instances where agricultural professors have failed to make good as agricultural managers because of their lack of business training.

From the address of the president of the Southern Section of the American Society of Agricultural Engineers at the meeting held at Lexington, Kentucky, February 14, 15 and 16, 1921.

The Economics of Standardization

By A. T. Taber
Taber Electric Company, Red Wing, Minnesota

THE recent war requiring, as it did, interchangeability and standardization of military material to an extent never before realized brought distinctly before the civilized nations of the world the importance of international standards. This matter was not settled by the conclusion of the war but becomes even more important as a vastly increased international commerce unquestionably will bring to the front the matter of international commercial standards in many classes of articles and materials. It is inevitable that the markets of the world will be available as never before, and with improved transportation facilities business will come to those who meet the conditions of demand and have their commodities most highly standardized according to some predominant or universal system.

So content are people to take for granted reasonably good or at least serviceable systems of standards in a single country or in a single industry that often they are liable to neglect the consideration of earlier conditions and, at the same time, the necessity for still greater improvements. When it is recalled that a freight car can be coupled in any train on any railway in the United States or Canada, and can also be repaired in any shop, it seems difficult to realize that at one time such a condition of affairs was practically nonexistent. Today there is the added incentive to standardization that many of the standards used in single nations instrinsically are subject to improvement, and if they are to be improved it is fair to ask that they also conform at the same time to other and better standards, and should be applicable throughout the entire civilized world.

In the matter of weights and measures we are bound by habit and custom. We think habitually in terms of feet, inches, quarts, gallons and innumerable other units, such as yards, hands, spans, rods, leagues, perches, fathoms, links, chains, furlongs, and miles, two different quarters, quarterns, ounces, minims, grains, drams, scruples, pennyweights, three different hundredweights, two different tons, and one tun, four different stones, four different pounds, four different ounces, two different gallons, two different quarts, two different pints, gills, many different bushels, pecks, and so on. Also we think with different units for different objects, dry measure, wet measure, wine measure, beer measure, avoirdupois, apothecary, troy weight, and so on.

Too Many Different Kinds of Measurements

We are the victims of an ugly mental slavery, and as a consequence Britannia and the United States of America are still essaying to play their part in the world with a German jumble of measuring units which Germany scrapped in 1871, and put in her museums beside bows and arrows, stone axes, stone adzes and other stone-age implements. But we are still annoyed with the inch, a twelfth of a foot; the foot, a third of a yard; the foot, a sixteen and two-fifths of a rod; the foot, a five-thousand-two-hundred-and-eightieth part of a mile; or the pint, a half of a quart; the quart, a quarter of a gallon; the gallon, an unknown part of a barrel. We are still pursued by those archaic measures, the gill, the peck, and the bushel; the ounce which is a sixteenth part of a pound except when it is a twelfth part of a pound; and the pound, which is a two-thousandth part of a ton, except when it is a two-thousand-two-hundred-and-fiftieth part of a ton. We still have units of measure which are as difficult to manipulate as the surveyors' link or chain, or the mariners' fathom or knot. We cannot conveniently wield them ourselves. And nearly all of the remainder of the world is serenely multiplying its centimeters by one hundred and getting meters, just as we multiply dollars by one hundred and get cents, multiplying grams by one thousand and getting kilograms, or dividing meters by one thousand and getting millimeters, and looking at us as wonderingly as we do at our sorely tried British cousin who is trying to determine how much ten articles will cost him when each one is priced at six pounds three shillings two pence.

Foreign Countries Adopting Standardizations

But aside from matters of war material, manufacturers and authorities in the United States and Great Britain, France and other foreign countries have been keenly alive to the industrial and commercial situation involved, and during the past year there has been considerable progress made toward international screw thread standardization, though little that is definite or actually accomplished can be recorded now. There have been numerous conferences between American and other national engineering commissions in regard to screw threads and pipe threads. In the opinion of the National Screw Thread Commission, which was established by act of Congress, approved July 18, 1918, and continued by a similar act approved March 3, 1919, to ascertain and establish standards of screw threads for use of the federal government, and in manufacture such an international standard thread should be established by giving consideration to the predominating sizes and standards used in manufactured products, as well as to the possibilities of providing a means of producing this international screw thread by the use of either the English or metric system of measurement. While important work has been done lately for various national screw thread systems, the undertaking will not be complete until one absolutely international standard is secured with proper definition and tolerances so that with taps, dies, and lead screws arranged on an interchangeable basis, all screw products could be reduced to a single system the world over.

Mr. Farmer, of the Beardslee Chandelier Company, Chicago, was elected president of the National Electric Fixture Dealers Association at a convention held at Detroit in February, 1920. The most significant thing about this convention was a tentative set of rules adopted to standardize and make interchangeable the fittings used in the fixture business and the vehement protest made against the absurd brass pipe sizes. Quick deliveries, better satisfied customers, rapid turnover, easy replacement of parts and accurate methods of matching colors and finishes—these and many more advantages will result if the National Council of Lighting Fixture Manufacturers succeeds in its efforts toward standardized fixtures and parts.

"Nations in the future," said Lord Northcliffe, "will be linked together by the motion picture. We cannot think of anything more international now than the motion picture." Why? Because the millions of feet of film that have been produced in this country and abroad are identical in every respect and can be run on any projector on the surface of the globe.

Considering its rapid growth and present magnitude the

electrical industry, thanks largely to Thomas A. Edison, is a splendid example of the benefits derived from standardization, interchangeability, and partial application of the metric system. Lamps made in the United States fit in sockets in every nation. Fuse plugs are not only identical except in amperage capacity but are also the same size as lamp bases. Thus one machine makes both, the electrician can screw a fuse plug in a lamp socket or a lamp in a fused cut-out for testing purposes; the manufacture of attachment plugs is simplified, and of the thirty-six different kinds in use at present we will see but one in the very near future. The electrical journals for the past year have been waging an aggressive campaign to standardize on the two-piece plug with the parallel blades.

Practically everything but glassware used by the electrical contractor comes packed in unit packages of ten, one hundred, or one thousand. Conduit comes in ten-foot lengths, ten to a bundle—not twelve-foot lengths, twelve to a bundle—so that checking shipments, invoices, discounts, and unit prices is done accurately in a moment. Only glass manufacturers are still sticking to a dozen-to-the-case habit, and when we order glassware we order ten or a hundred and make them repack. This makes them all peevish and costs us a few cents more, but we will continue to do so if it puts us out of business. Think what the slogan "110 volt 60 cycle" has meant to the electrical industry.

These are but a few of the many activities taking place at the present time and indicate very clearly the trend of popular opinion. In them the progressive manufacturer will see the writing on the wall and lay his plans accordingly.

Standardization Means Conservation

All that the human race can do in the material world is to move matter. There is much talk of the pressing need for conservation of this matter, of the dwindling supply of oil, timber, coal, and of America being great in spite of our best efforts to exhaust her resources, but how much do we hear of conserving the two most precious of our possessions, the very means by which this matter is moved, time and human energy? Very little, and yet, like a giant long asleep, this great nation is beginning to awaken to the fact that for every dollar and every hour spent in production, another dollar and another hour is spent in maintenance, and that one-half of the latter, and in its turn inevitably one-quarter of the former could be saved by standardizing and making interchangeable all machine parts which have a common function and operate under similar conditions. Where is the statistician who can give us data on the vast amount of time, money and energy wasted yearly in trying to drill a hole for a 25/64-inch shaft like the shutter shaft on a Simplex projector; in trying to cut a fine thread on a ½-inch rod with a ¼-inch pipe die and find you cannot do it because the bolt is a hair smaller than the pipe; in trying to screw a ½-inch twelve-thread nut obtained from the blacksmith on a ½-inch thirteen-thread bolt furnished by the machinist; in trying to fit one-half of a pipe union made by one firm to another half made by a different firm and find the binding nut a trifle too large or too small or a different thread. The plumbing industry is the limit. Petty jealousy, wrangling, and a "public be damned" policy have resulted in a multitude of small fittings, all serving the same purpose and yet no two alike or having interchangeable parts, a hodge-podge jumble of special sizes and threads that is little short of miraculous, and reminds one of the traditional definition of the coffin: The man who made it didn't want it; the man who bought it didn't use it, and the man who used it didn't have much to say about it. In every plumbing shop in the country is an accumulation of parts of fittings, valueless because the other part has been lost, a disgraceful pile of junk representing a waste of time and energy that should have been saved, and a burden that is eventually foisted, with the other legitimate overhead expense, on to the shoulders of the ultimate consumer. Imagine trying to drive your car in sand or snow in the ruts made by the broad-gauge car of the South or the narrow-gauge sleigh of the North; or trying to fit a Paige ring gear on a Buick car. We had this very experience last summer; stripped our ring gear on a trip in the North Woods on some "graded" roads, and after spending twenty dollars on telephone calls, and a week's time in a futile search for a new ring gear, I found an old Paige gear that fit to perfection, except that it was a trifle too thick to allow adjustment to the pinion. How we finally got home is too long a story to tell here, but I'll never take another trip in anything but a Ford. Most any old thing will fit a Ford; bolts and nuts have standard threads and are standard sizes. Bearings are of even dimensions that most repair shops in any line have drills and taps for, and besides these parts lend themselves readily to repairs on other machines. We have used Ford bushings on water pumps, motors, washing machines, and every place where we have had to replace a bearing; we have used them for two reasons: First, when they wear out they can be replaced immediately and, second, because you can buy five of them cheaper than you can make one.

Standardization Permits Quantity Production

Aside from quantity production there is another very good reason for the low cost of Ford parts. Their standardization has enabled a great many small concerns to specialize on the manufacture of some particular part, and with a comparatively small investment in standard tools turn these out in spare time and market them at a profit. Fire departments in progressive communities operating under a competent city manager could readily be organized to turn the spare time of the "paid crew" to a profit that would help materially in cutting down the overhead expense of the department.

Has Ford suffered any loss by this policy of standardization? Has the electrical industry been handicapped by the interchangeability of fittings and appliances? Or had they and the movies been better off to adopt the confiscatory policy of so many manufacturers who think that by compelling the public to come to them for repairs, they can make a fatter profit, who hold the dime so close to their eye that they cannot see the dollar within reach?

It is high time for this great industry to rise from the status of empirical art to that of cooperative applied science, and the vast amount of energy at present wasted turned into channels of production. Too many of our population have not the slightest conception that there is such a thing as an actual science of economics, and many of those who have had no true conception of its principles. This statement does not refer exclusively to those of little schooling. There are many so-called "highly educated" people who are still clinging strenuously to false conceptions and theories abandoned long ago by practical economists. The day when the majority of voters will be prepared by education to vote correctly on the great economic questions is in the far distant future. Nevertheless, there are certain fundamental principles that are almost axiomatic. For example, it should be realized that a person's purchasing power is his producing power. It should be realized that the greater the production, the greater the prosperity. It should be realized that any kind of waste cuts down the producing power, and therefore the earning power. These are most elementary and fundamental principles. It would seem that they are obvious but, on the contrary, they are to a large portion of our population by no means obvious. There are hundreds of thousands of people today advocating the reduction of individual output as the only cure for all industrial ills. Our country must have greater production in the immediate future if it wishes

to maintain its supremacy in world trade. The employers want more profits. Labor wants higher wages. The people must have greater individual purchasing power. This combination can be helped only by eliminating waste. Let us not postpone the beginning of this campaign until the division of the profits resulting from it have been determined and agreed upon. The savage Indians knew better than to postpone the accumulation of spoils until after the arrangement of division was determined. Let the accumulation of the spoils begin at once.

It is admitted that the financing of such enterprise is a tremendous undertaking which, however, points to the truth that we are not only upon the eve but in the realm of far larger things than have concerned us in the past. Yesterday we were willing to spend a million dollars in construction to save a hundred thousand a year. Today we are ready to spend a billion to save a hundred million a year. We have spent billions for destruction for preservation; now let us spend billions for construction for conservation.

And the time is ripe. Our men abroad have returned imbued with a greater vision. Contact with the metric system has shown them its advantages. Suffrage, prohibition, reforms, and inventions that twenty years ago were scouted as impossible are today realities. Are not even the women of Egypt who have been held in the most absolute bondage since the dawn of history this very day crying on the streets of Cairo for liberty and self-determination? And yet we sit here with all our advantages of education, prosperity, science, industry, and Yankee ingenuity, and placidly endure a bondage even more stupid. Will not our grandchildren look back upon our lack of efficiency with as little tolerance as we consider the primitive methods of our forefathers?

We here shall not live to see the day, we can merely do our bit to hasten its arrival, when criminal wars such as we have just passed through cannot be foisted again on an innocent and unsuspecting world; when the vast machinery of destruction and the vaster human energy which is day after day and year after year being poured into the insatiable maw shall be turned to production, through a common language, a common system of weights, measures, and money, and eventually a common brotherhood of mankind. There will always be those who say "it can't be done." There always have been. They were right on the job when Henry Ford suggested standardization of automobiles. Their doleful chorus was in full blast when the Panama Canal was started. But because those things were needed they were done.

Discussion on the Draft of Plows

Editor's Note: This discussion followed the presentation of the paper, "Factors Influencing the Draft of Plows," by E. V. Collins, assistant chief of the agricultural-engineering section of the Iowa agricultural experiment station, Ames, Iowa, at the fourteenth annual meeting of the American Society of Agricultural Engineers held at Chicago, December 28 to 30, 1920. Mr. Collins' paper was published in the February number of Agricultural Engineering. Following the reading of his paper, Mr. Collins showed several lantern slides, and the first part of the following discussion has reference largely to the slides.

QUESTION: What is the difference between the speed bottom and the general-purpose bottom?

MR. COLLINS: It is not as steep a plow. The stubble bottom would work best at, say, two miles per hour and the other would do better work between that and three miles. After you get up to three miles the speed plow would lay the soil over all right, but if you run the speed plow at low speeds the edge of the furrow would not be tucked under. This is a new bottom developed by the Vulcan plow people.

QUESTION: Does it more nearly approach the breaker bottom?

MR. COLLINS: No, it is more like the general-purpose bottom, but the moldboard is shorter and has less pitch to it. It avoids the throwing of dirt at high speed. I have not said anything about the quality of work on these tests because that was not the thing we were after. It is hard to judge the quality of work on some. We took the stubble bottom first and ran it a mile and a half an hour. We ran the next one three miles an hour, the next four and a half miles an hour, and we did not have a very nice job of plowing as you can realize. There was not a good opportunity to judge. We wanted to find out if we could get rid of this increased draft at high speed; that was the primary object.

QUESTION: What type of soil did you have in the B-2 field?

MR. COLLINS: Sandy loam.

QUESTION: Is the depth the same?

MR. COLLINS: The depth was seven inches in this field. We ran this in the same way, that is, we put on one bottom and ran it at different speeds and then put on the next.

QUESTION: How deep had that ground been plowed previously?

MR. COLLINS: I think about the same depth; it has been plowed eight inches deep. This chart shows that with the different soil conditions you are going to have a different rate of increase in speed. Some of the men who have tried tests on the effect of speed concluded there was very little increase. I can realize under certain soil conditions you will get a very slight increase where the moldboard has very little to do. The share cutting breaks it loose and there is no more pulverizing done by the moldboard.

QUESTION: Do you have data on maximum speeds at which each of those bottoms will do good work?

MR. COLLINS: No, as I said, we did not try to determine the quality of the work. I would not undertake to say anything about the quality. Take a stubble bottom or a breaker bottom, for instance, and in ground that does not hold together like sod, it does not make much difference how far you throw it. You found that in sod, using the general-purpose bottom, it did not make much difference whether you went fast or slow because it would leave a ragged job of plowing. It does not throw sod as bad as it does the other. It will strike the other furrow and lay it. I do not say that the general-purpose bottom will do anything like the work that a sod plow will in sod but the effect of speed on the general-purpose bottom in sod was not what I anticipated. I suppose you could throw it over in big chunks and do a worse job than at ordinary speed.

QUESTION: Did the slice cutter cut the horizontal and vertical slice?

MR. COLLINS: Yes.

QUESTION: You ran it through first, loosened up the slice and then ran the plow through to lift and turn it over. That was merely an L-shaped blade to cut the slice, was it not?

MR. COLLINS: Yes, the vertical part of the blade ran down to cut the vertical part of the slice. There was a coulter there, too, to cut the trash in the furrow. It was attached directly to the bottom of the sled.

QUESTION: How did that test compare with where you cut and turned the furrow in the same operation?

MR. COLLINS: The slice cutter pulled harder than the plow itself. You have a straight blade there and you have to put additional weight on the slice cutter to make it stay in the ground.

QUESTION: Was the draft of the slice cutter subtracted from the work you did?

MR. COLLINS: We subtracted the draft to turn the slice

after it was cut from the total required to plow. For one thing, our coulter gets no relief on that, that is, the soil is not turned away from the coulter on the slice cutter; it has friction all along. In a plow you turn the dirt away and relieve the cutting edges.

QUESTION: You had a sliding friction instead of a rolling friction, didn't you?

MR. COLLINS: We had a sled in the furrow and wheels on the land. This would be a good illustration: When you want to slit a strap of leather, you pull apart on the two pieces. If you cut straight down with your knife, it cuts harder than where you pull the two pieces apart as you cut. That would be my explanation. Only in two of the fields was I able to get the plow to scour after the slice cutter. You do not have good scouring conditions after you cut the slice loose.

(Slide showing slice cutter) The rolling cutter is here. The knife comes down eight inches below the sled and over here is the back of the other sled runner. That runs into the bottom of the furrow to obtain depth and width. It was hitched so that this runner would hug the furrow and give uniform width. We had a weight on it holding it to the ground the uniform depth. We also had considerable suction on the blade.

QUESTION: Did you get the same amount of pulverization where the furrow slice was cut by the slice cutter previous to turning?

MR. COLLINS: Yes, I think about the same.

QUESTION: Do you think the slice cutter has considerable suction? Will it materially pulverize the slice?

MR. COLLINS: The blade was only two inches wide. The bottom edge was a little dirt crumpled, but the furrow slice would be continuous.

QUESTION: What was the shape of the lower knife, the same as the shape of the plow?

MR. COLLINS: It went straight across the furrow. The knife went straight down and then a square corner straight across was made. It does not give the shape of the plow. I realize that you could not expect to compare that favorably with the plow—the draft I refer to—because you get no relief from your cutting edges and I think the other is a more fair way to define the draft due to cutting by subtraction.

It was difficult to get a satisfactory test there and get the two depths out of the depth of the slice cutter running and the plow so that it would be satisfactory. In each of these cases I was able after several attempts to get them to run at the right depth.

QUESTION: Did you finally check the drawbar pull of that outfit the way it is attached to the plow?

MR. COLLINS: No, the draft of this outfit was generally a little heavier than the total draft of the plow so we went at it the other way, subtracting the power required to turn the slice after it was cut from the total required to plow.

QUESTION: If you had a properly shaped plow bottom, do you think the subsequent preparation of the ground would be reduced any by plowing fast?

MR. COLLINS: I doubt if you could make a farmer believe that. Of course there would be quite a difference, but a great deal depends on the condition of your soil as to just how it is going to be left. I do not feel in the spring they will be able to tell which plow did which furrow. There will be a little gap because the next furrow was not run anything like that speed. There is no question but what the different types of bottoms will do different classes of work. The point we want to determine is whether there is a difference in draft due to the different types of bottoms and whether we could get any indication that a bottom could be designed for high speed with as little draft as the ordinary plow at ordinary speed. I am satisfied that a plow can be made to do good work at high speed, but the tests we have run would indicate that you must expect a considerable in draft.

MR. KRANICH (president of the Society): Mr. Collins' talk was very interesting, and particularly so from the fact that the increased speed means increased power. I wonder if after all the work that is done—the quality of work which will take more power—isn't worth the additional expense? Another thing I thought about was the statement made by Mr. Collins that this was fall plowing and the soil was not very well pulverized. In fact, the picture Mr. Collins showed appeared to be a very rough job of plowing, but as someone has said, for fall plowing the farmer rather prefers to plow with the least expense and leave it a little rough because he feels that the ground in the spring of the year, after alternate thawing and freezing, will of itself disintegrate and make a pretty good seedbed. It will look considerably different after the snow leaves it and the frost is out of the ground than it does in the fall. There are a good many factors that are going to be difficult to determine really and one in particular is the quality of the work.

JAMES A. KING (Mason City Brick and Tile Company): In that connection a number of years ago we were making a number of comparative tests with plows speeded to work at two and one-half and four miles an hour. We tried the general-purpose bottom, the stubble bottom, and the tractor gang plow at those two speeds of two and a half and four miles. Every farmer that took a look at the two jobs expressed the opinion that the four-mile job was nowhere as good as the two-and-a-half-mile job. It threw the soil and there would be a big gob of dirt here and an open space there, and then another big gob of dirt, much on the principle of a fish net. It made an irregular job of the lapping of the furrows. That was the experience we had some eight or nine years ago.

O. B. ZIMMERMAN (experimental engineer, International Harvester Company): Undoubtedly we are up against a very serious problem here, as we all know, with such a large series of variables, in attempting to analyze, differentiate, and find out the effect of each one.

ASCERTAINING MATHEMATICAL RESULTS DIFFICULT

One of the most serious problems in ascertaining the exact results mathematically is the fact that where a tractor has gone over the land that we are trying to analyze, especially in mass data, we have a disturbance of the soil, caused by the lugs and wheels, which influences the securing of very correct data in regard to plowing with tractors. I have noticed that particularly in watching the tests we have been carrying out at Hinsdale. Ofttimes data which is recorded with a Gurley dynamometer will indicate a falling off, for example, of the draft relatively with respect to speed when you change from two miles to three miles an hour. You can see very well that the influence of the lug action at the higher speeds disturbs the ascertaining of accurate results to an extent which has to be corrected unless you can operate the plow on absolutely unaffected soil. That is a point I was very anxious to find out about Prof. Collins' data—whether all of the cuts were made in soil which had not been affected by wheel or lug action of any kind. That influence was particularly noticeable in some of the tests made at Ottawa Beach at the time of the meeting of the Society of Automotive Engineers in Michigan last summer. I noticed the tracklaying type of tractor pulling plows at variable speeds. At the lower speeds the influence of the tracklaying type of tractor on the ground was not noticeable. When you walked along beside the tractor the disturbance did not penetrate deeply, but when it got to the higher speeds the entire surface was sheared by the action of the lugs. Naturally the draft data taken from the drawbar was that of power required to turn over this soil without the actual cutting, since part of that work of shearing and disturbance had already been done by the lugs.

MR HOYT: To what depth was it disturbed by the lugs?

MR. ZIMMERMAN: To the full depth of the cut, the shear line took place right at the bottom of the furrow. It made a

deep impression on me that we would have to be exceedingly careful in the analyzing of data when we were in soil where the lug action did grip the soil in shearing or did disturb it to a large extent. That shows that we have really two very vital problems in tractor plowing, one of which is the plow action in which we must secure at the maximum sensible disturbance of soil, the minimum sensible amount of power, and on the tractor we have to design the wheels in such a way as to reduce the minimum amount of soil disturbance. That is where our big problem lies. The two are distinctly opposite problems. I am satisfied that in the tractor industry we have not as yet given sufficient attention to the getting hold of the soil with the minimum disturbance of the soil. By minimum disturbance I mean minimum sensible packing and minimum crushing and breaking up, because the object of the lugs is to get a grip and to give us a possibility of exceeding the resistance which we are trying to overcome with the plows.

MR. HOYT: Do you think that is an important factor in practical work?

MR. ZIMMERMAN: I think it is very important in both factors, because until we know what the power is and what the controlling engineering theoretical data is of the undisturbed soil, we cannot well solve the tractor problem. Our first problem is to analyze theoretically and practically the soil disturbance and see what can be done by shaping the moldboards and other factors of the plow to give us the minimum amount of power and the maximum soil disturbance. When we have done that we should take up a study of the lug action, irrespective of the plow, to get a maximum drawbar pull. Putting those two together we can make a thoroughly sensible analysis of the tractor problem.

J. B. DAVIDSON (professor of agricultural engineering, Iowa State College): In connection with Mr. Zimmerman's remarks, the significant feature of Mr. Collins' observation is the fact that the type of plow bottom does not materially affect the draft. There are a good many men here who have been in my classes and you know I argued that it cost in power to pulverize the furrow slice; that is, if you used the stubble bottom you would expect the draft to be higher than if you used the general-purpose bottom, and likewise still higher if you used a stubble bottom in place of a breaker bottom.

The observations have not worked out that way, and as you stop to analyze the thing you see why it does not work out that way. In the first place, in the breaker bottom you have a long section of the furrow slice and you are carrying that on a plow bottom—on the share and on the moldboard—and you are pushing it along. You have a great deal more weight, fourteen inches wide, so many inches deep and greater length, and you are pushing that along on top of the plow bottom. You would expect the resistance to be greater even if you had dry friction. In reality you do not have dry friction; you have something between dry friction and liquid friction, and liquid friction varies with the amount of surface in contact. I suspect in analyzing Mr. Collins' result you would find that with the soil full of moisture the breaker bottom will pull heavier than when the soil is dry, and as you think of it, it is a thing that you might expect. I believe it might be possible to take advantage of that principle and change the plow bottoms so we would have this draft as Mr. Zimmerman suggested. Maybe we want an extremely short movement to carry as little of the furrow slice as possible. True enough we don't carry it all vertically, but we carry it part vertically and part is used in shoving it over. The breaker bottom may not be the lightest draft bottom. Practical men have told me they have known that for a long time.

MR. COLLINS: In connection with the effect of scouring on high speed, I would like to ask Mr. Zimmerman if they have had any experience along that line. My observation was we had some difficulty in scouring at high speed. It was not what I expected.

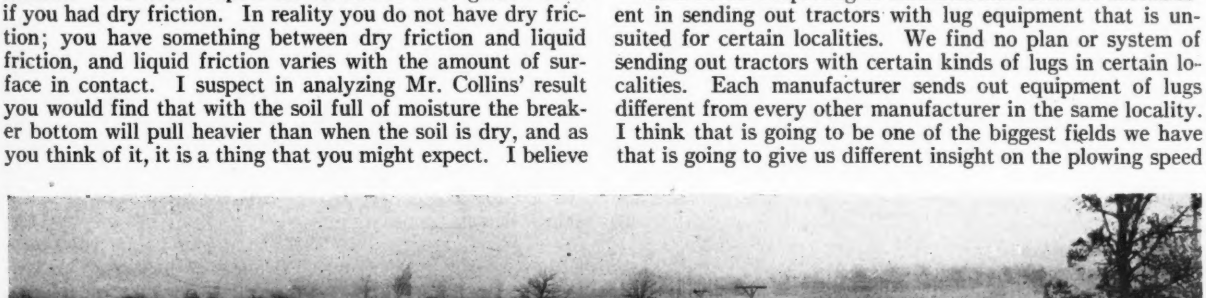
MR. ZIMMERMAN: We have analyzed that, that is, we have argued about the question a good deal and we are thoroughly satisfied when you get below one mile an hour the draft increases abnormally with the speed, so that while we have no direct data on it, I would say roughly that the curve of resistance drops down and rises when you go for considerable miles.

HENRY GREEN (International Harvester Company): My field experience has been with the horse plow that, if you have scouring difficulties, run a little shallower and speed up. That is the general impression among most farmers. Possibly a little shallower plowing brings you into a little different strata of soil. That is likely the reason for it, but the general impression among all farmers is when you have scouring difficulties go shallow and fast.

PROF. DAVIDSON: With a horse you are limited to less than three miles an hour, but when you get to six miles an hour you have a different speed. Isn't it possible that you have areas of low pressure which result in nonscouring? My observation has been if you go less than a mile an hour you have trouble in scouring.

MR. KRANICH: I saw some tests made in South Bend a year or so ago in which difficulties were encountered in scouring at two and a half miles an hour, whereas when the speed was increased to three or three and a half or even four miles an hour, the plow scoured very easily. That is common. We also found that in taking off the jointer and even the coulter, it has many times absolutely caused the plow to work perfectly when it otherwise would refuse to scour at a moderate tractor speed and it would do as good a job of plowing, apparently, as with them. Mr. Zimmerman brought up a subject that I think is a very important one. Of all of the work we have done on plows, tractors, and tractor work, I think we know less about wheels and lugs than any part of our tractors, and it seems to me that affords a field for work as great as any. The effect of lugs on ground of different kinds is very important. We have nothing to guide us that I think is at all logical.

It is rather surprising to find manufacturers so inconsistent in sending out tractors with lug equipment that is unsuited for certain localities. We find no plan or system of sending out tractors with certain kinds of lugs in certain localities. Each manufacturer sends out equipment of lugs different from every other manufacturer in the same locality. I think that is going to be one of the biggest fields we have that is going to give us different insight on the plowing speed



and draft, and I hope that work along that line may be carried on this next season that will open our eyes in another direction.

Mr. Zimmerman spoke about the effect of the tractor wheels on the ground. Perhaps we will have to go back to the cable plowing, where they do not run the tractor on the ground at all, to get the results of the plowing independent of the effect of the wheels. The quality of work that the plow does is in a big measure also effected by the hitch. We have seen at the various demonstrations, the quality of work of the different manufacturers, working side by side in apparently the same soil, differ one hundred per cent, due entirely to the fact that they had an improper hitch. It makes for bad work, not alone with the plow but the entire outfit.

Mr. Zimmerman: Has the American Society of Agricultural Engineers taken up the question that is really vital to every one, as to what actually constitutes good plowing? Unless we know what we are driving at, we cannot arrive. I am quite well satisfied that there are too few of us who really know what we are driving at when it comes to analyzing this question. Of course, we have seasonable conditions that are required.

In the fall we do not care, as has been said here, if there is more or less in the way of lumpiness in the results of our plowing, but in the spring when we are endeavoring to get a seedbed in the fastest possible time, then it becomes another question and I think that our Society should take that up as a vital question, it has been definitely put on the program to get down to basic facts and see what we are actually trying to do with the soil.

O. W. Sjogren (professor of agricultural engineering, University of Nebraska): The question of roughness or smoothness of the plowing in the fall may hold for localities where they fall plow for corn, but certainly not for Kansas and Nebraska in the winter-wheat belt. There they want smooth plowing in the fall for wheat. They do not do much spring plowing. It depends on the locality.

In regard to the speed, we ran a few tests at Nebraska this fall to determine the effect of speed and depth and various other factors upon plowing. We have not gone far enough to draw definite conclusions. We found with the plows we used—the general-purpose plows—the higher the speed, the more inferior the grade of plowing. The soil would be thrown a considerable distance and would be choppy as Mr. King said they found it. The trash was not as well covered with the higher speeds as with the medium speeds.

Mr. Kranich: I think this is a subject we have all got to take seriously. We have to get down to a basis somewhere that is consistent and reasonable for the protection of the people who farm without endangering their lives or destroying their property.

Wm. Aitkenhead (professor of agricultural engineering, Purdue University): The work we did part of the past summer in connection with tractor lugs was done in exceptional soil, that is, sandy soil but with clay. It made better conditions as to holding because as soon as the lugs cut through the crust the holding power was gone. We found that angle-iron lugs are almost useless. Each subsequent lug cut through the crust of the soil and pushed the piece back. We did this several times. We drew the plow over a measured distance empty, using two plows with an average draft of 1300 pounds. With the 1300 pounds behind the angle-iron lugs we would get as high as 40 per cent slippage. We studied it from that basis. We finally concluded if we saw the track made by a tractor we could pretty nearly tell whether they were good lugs or not. It isn't so much a question of propelling surface in the lugs as holding power of the soil. With any form of lug that made a cut across the width of the rim of the wheel, we had very unsatisfactory results. The holding power was lost. Not because the propelling surface was too small, but we cut with a series of lugs and pushed them back. We found out that the best holding was a spade lug three inches high and three inches wide. With a lug of this kind on the same basis of calculation as with the angle-iron we got to a basis of 3 per cent slippage. The lug that gave the best holding power made practically no disturbance of the soil and I think that designers in making the curvature of tractor lugs must consider that a lug that will slip in and be curved so, when it leaves the soil, the soil will not be sheared, is best. It has been said again and again that the conditions of the farmers are not common. The ground may be sandy and at the same time the crust hard. I saw one of the tractors with extended angle-iron lugs stalled with the empty plow. It stood and chopped. We could plow with the small angles but not with the big ones.

Mr. King: I hestitate to talk about tractors because I retired seven years ago, but I want to go back to what the gentleman over here referred to, the matter of relation between speed and the speed at which the plow is designed to work best. The plows used in the instance referred to previously were designed for tractors which were operating at a speed of somewhere between a mile and a half and two miles an hour. We found they gave the best results at that speed. Increased to four miles an hour we got inferior work. After four years of continuous experience in the field with tractors I have this thought impressed on my memory: That one of the greatest fields for the development of the tractor is a proper synchronization between the particular design of tractor and the particular implement which it draws.

Mr. Collins: Prof. Aitkenhead made some remarks that remind me of an experience I had in Kansas. We had a patch of alfalfa on a river bottom, largely sand. We were plowing that with several tractors. Our experience was that the extension angle-iron lugs were the only thing we could go into that field with and get out. The machines with the spade lugs had to be pulled out with the other machines. We buried them and had to pull them out. We depended largely on the alfalfa plants for the traction. The angle-irons would get hold of it and the spade lugs had nothing to get hold of. That led me to the opposite conclusion from that of Prof. Aitkenhead. I have changed my views a little on account of Prof. Aitkenhead's experience.

Standardization

Every farmer is interested in the subject of standardization as it refers to farm machinery. If standardization means anything it means conservation and economy, and standardization in the design, materials, and parts of a machine when scientifically carried out not only tends to increase the efficiency and improve the performance of the machine, but it also tends to improve the service which the farmer receives from manufacturer or dealer. In fact, standardization and the elimination of superfluous sizes and styles of machines is something that should receive hearty support.

However, one of the serious obstacles to the progress of standardization at the present time is the overcoming of certain prejudices that have grown up in different sections of the country for certain designs that are most popular in those sections. In many cases there is little if any reason for these prejudices except that the users have become accustomed to certain styles or designs and it is not always easy for them to accept something which will in every way be just as satisfactory, and which possibly would be a step forward in the progress of standardization development. It is well, therefore, for users to encourage the standardization movement to be willing to sacrifice their own whims and thereby assist the general movement of standardization.

Standardization of Agricultural Engineering Instruction in the South

By Daniels Scoates

Mem. A.S.A.E. Head of the Department of Agricultural Engineering, Texas A. & M. College, College Station, Texas

THERE is need of standardization of instructional work in agricultural engineering in the various agricultural colleges of the South because it will bring about so many desirable effects. This standardization can very well be carried out because conditions in the South are similar, thus allowing the same courses, with a few possible exceptions, to be offered with the contents of these courses practically the same, and the aim or purpose of the courses identical. There are several advantages to be derived from this standardization:

1. A student changing from one school to another will receive credit for work done in the first school because each school will be entirely familiar with what the others are doing.

2. New agricultural engineering departments as they are organized in the various Southern colleges will have at their hand a very well worked out program showing what courses should be given and of what these courses should consist. Many of the colleges organizing these new departments are having a hard time getting experienced men due to insufficient funds or the difficulty of finding trained men, hence colleges are forced to start the work with inexperienced men just out of college. Then too in a large majorty of cases these departments are only one-man departments. They must start that way. Therefore, any assistance in course outlines would be of considerable value to these men.

3. It would result in a student getting better courses because the outlines would have received much more thought due to the fact that several men would have worked on them in place of one.

4. There would be created a sufficient demand for a text in the various courses to encourage someone to prepare it not only for the theory but also for the laboratory work. Instead of having one man write a text and thus standardize a course as it is now, you would have a group of men prepare an outline and someone write the text from this outline.

5. It will mean that agricultural engineering will develop faster and become more widely recognized as a leading subject in the agricultural colleges.

There are ten courses given in agricultural engineering in the South, which are given here by the names by which they are most commonly known:

- Farm machinery
- Farm motors
- Tractors
- Agricultural surveying and drainage
- Farm buildings or structures
- Concrete construction
- Automobiles and trucks
- Irrigation
- Farm shop or farm mechanics
- Road Construction

It will be well if we went over carefully the names given to the various courses and saw to it that they were appropriate, decide on just what names should be used in each case and then everyone use that name. While this is a little matter yet it takes time to educate students, faculty, and the general public to the meaning of different names and we should not be at cross purposes on even this thing.

Take, for instance, the subject of "farm motors," the agricultural engineers know that "farm motors" means a very definite thing. It means all the power units on the farm. However, to the ordinary layman when we speak of "farm motors" he immediately thinks of the electric motor used on the farm. It is a hard name to handle for that reason, but even at that I am perfectly willing that we should use "farm motors" for a course which comprises farm motors. But as far as my own experience in teaching this course is concerned, I find that we do not have sufficient time to handle the entire field of farm motors in our "farm motors" course.

The student comes to the agricultural-engineering department calling for instruction in the gas engine as a farm motor because it is the one motor which has come lately into general use on the farm and about which he must know more if he is to operate it successfully. Hence, our farm motors courses are courses in gas engines. Then why not drop the name "farm motors" as a name for a course, if we only teach gas engines in it, and call the course "elementary gas engines." We are planning to do that in Texas this year. I agree that possibly it would be better to take more time and cover the horse, electric motors, water wheels, windmills and steam engines in a course with gas engines and call it "farm motors," but, on the other hand, you have to consider the question of getting time in the agricultural course of study to teach these things. I take up just this one course for an example in the subject of the names of courses to show what I mean. It would be well to go over each course and study the name given to it very carefully and see if it completely "fills the bill," and then standardize that name. I am sure we would find it a comparatively simple matter to change any of the names of our courses that it is necessary to change.

The standardization of purpose or object of each course is of the utmost importance. We should consider very carefully just what we are trying to do in the courses we are offering, how far we should take the student and just what we are preparing him to become by taking that course. There has been some misconception of what we are trying to accomplish in our courses. In the main, with our four-year agricultural student our endeavor should be to make him a better farmer and give him an insight into these subjects just sufficient to enable him to handle his farm to better advantage. Take the course in farm buildings or farm structures for example; we are not interested in making him an architect, nor are we interested in making him a carpenter, but we are interested in getting him to appreciate the value of better farm buildings, giving him the essentials which must enter into each type of building and showing him the various types of buildings that have been developed together with the advantages and disadvantages of each of them. Also we are interested in giving him a little insight into types of construction; giving him some contracts and specifications, and teaching him how to figure bills of material. Each course should have its object very clearly defined.

If we are to exchange grades in the different schools as students pass back and forth, it is necessary that the scope

Paper presented at the Southern Section meeting of the American Society of Agricultural Engineers, Lexington, Kentucky, February 14, 15 and 16, 1921.

of the courses both as to theory and laboratory work should in a general way be the same. Of course there will be a variation in this, due possibly to the different conditions that are present in different states, but in the main things will be the same. It will be up to the individual instructor to determine what particular parts of each course he must emphasize as the allotment of time and subjects is entirely within his hands.

It is fundamental that a very complete outline of the course should be made and only those things incorporated which will help out and contribute to the purpose and object of the course. We of course appreciate that this is a big job, but if agricultural engineering is to go forward and be recognized as it should be recognized, the instructors who are teaching it in our various colleges must do the best possible job, and if a course is to be taught to the best advantage it is certain that the subject matter which the course contains must be very thoroughly collected and very thoughtfully analyzed. The better this work is done the better the final result.

Of course this must be done if there is to be any exchange of credits. In filling out the number of hours to be given to each course it should be worked out on a term basis of eighteen weeks to the term for schools having two terms to the year, and on a term basis of twelve weeks for the school having three terms to the year.

We have not been giving enough time to some courses. Take, for instance, the course we teach in tractors in Texas. We have always offered that as a one-hour theory and four-hour laboratory course. I taught the course one year myself and I found that one could do practically nothing in but one hour for theory. The tractor is a big subject. We require in Texas that before a student takes the course in tractors he must take our farm motors course as a prerequisite. In this tractor course we give some additional multiple-cylinder work and then try to cover tractor design (only in a limited way to assist in selection), operation and repair. We are changing this next year to a two-four course but it may be that it should be a three-four course. However, we are working out a very carefully prepared outline and will know just what we are doing hereafter. It may be that there are other courses we are teaching in which an increase in time might very well be made. Of course, there is this fact to be considered, that a large number of our courses must needs be lecture courses, and as texts are developed for these courses we will be able to cover much more ground in the same time.

One of the biggest things we can do for the furthering of agricultural engineering instructional work in the South is to outline carefully a standard agreement for the handling of loaned equipment obtained from the manufacturers, jobbers and dealers of machinery, gas engines and tractors. When we have this agreement thought out and drawn up we could not do a bigger thing than to follow it out absolutely as far as our end of the contract goes. There is no doubt but that manufacturers have not always received a square deal from the agricultural colleges on what has been loaned them. This equipment has been abused, lost and used in the field without consent. This has resulted in the manufacturer withdrawing his cooperation in many cases. We have all had interviews with representatives of manufacturers who have been very bitter when discussing the results they have obtained from loaned equipment to agricultural colleges. This state of things should be corrected at the earliest possible moment. There is no doubt it is being corrected gradually, but if one state college gives the manufacturer a very bad deal it reflects on the other states, and they immediately feel the result of that abuse of the loan privilege. Thus it is of the utmost importance that all of us work together and in entire harmony with the manufacturer. On the other hand, we should demand a square deal from them for ourselves and get all that we are entitled to.

Some of the things which should enter into an agreement of this kind are:

1. Whether the company will allow the use of machinery in the field or not. As a general thing they do not want to do this, but want it set on the sample floor for the study of the students. In some cases, however, they will allow it to be used in the field.

2 Loaned machinery should be properly stored.

3. Who carries the fire risk? If the machinery is housed in a fireproof building this is not of so much importance, but if it is not then an understanding as to who carries the insurance may save trouble some time.

4. Handling of extra parts and tools. The extra parts and tools which come with machines should be labeled and taken care of and when the machine is shipped back to the manufacturer these things should go with it. The manufacturer is entitled to get back with his machine all the parts he sent, even to the smallest wrench. Otherwise he has a loss. If this were done in every case the manufacturer would react better to our demands for machinery.

5. Paying freight charges. In all cases, except where the machinery is an outright donation the manufacturer should prepay the freight. He can charge this freight against the machine and when the machine is moved from the college to the ultimate consumer the freight charges can be applied to the sales price.

6. Moving machinery. The machinery should be moved frequently. It should not be moved every month or two, but every six or nine months. This allows only an up-to-date machine to be in the laboratories.

. Who unloads and loads the machinery? Manufacturers do not always understand that the colleges will unload, set up, and then knock down and ship the machinery without charge.

The question of laboratory equipment needed for the different courses is an important one. It would be well when these various courses are outlined that an outline be made of the different types of machines and apparatus needed to handle such a course satisfactorily. There should also be submitted a report showing the possible places of getting such equipment. There is no doubt that such a list would be of considerable value to a man just organizing a department or to a man who possibly is the only one in a department.

With reference to these recommendations for standardization and getting somewhere with the work of carrying them out, I would like to suggest that committees be appointed to work on different courses. Perhaps it would not be well to start to work on too many courses this year. I suggest that two committees be appointed to work on different courses. Another committee could be appointed to work on the standardization of handling loaned laboratory equipment. I feel that the sooner we get this thing worked out and get the results the better off all of us will be.

It may be argued that standardization of instruction will interfere with the exercise of individual talent and progress of the subject. These arguments probably have been advanced in opposition to every piece of standardization ever attempted. The fact that individual talent has asserted itself, and that the arts and sciences, including those of instruction, have progressed, and usually have progressed more rapidly after than before standardization, should be a sufficient refutation of the objections. Standardized courses such as proposed, being the combined experience of several institutions and many men would in any case afford a better point of departure for variations to suit local condition either of personality or of problems, than if it were necessary, as is now true to too great an extent, for each worker to construct his own plan from the beginning.

Discussion on Land Clearing with Dynamite

Editor's Note: This discussion followed the presentation of the paper, "Land Clearing With Dynamite," by Arthur L. Kline, Hercules Powder Company, Wilmington, Delaware, at the fourteenth annual meeting of the American Society of Agricultural Engineers held at Chicago, December 28 to 30, 1920. Mr. Kline's paper was published in the February number of Agricultural Engineering.

Question: What is this new machine for stump pulling that you mentioned in your paper?

Mr. Kline: The reason I did not go into that is because it has just recently been developed. It is known as the Bissell stump puller. I have read descriptions of it, although I have not seen it. A large steam donkey engine is mounted on a tracklaying tractor and there are two drums on which the cable is drawn. The cable is spread out in a large loop from each end of the machine in the form of a figure eight. The engine is sufficiently strong to contract this loop by winding the cable on the drum so as it tightens up against the stump it pulls it over. When it has pulled the stump over, it tightens against the next in line. The pull from both sides tends to counteract any pull that might be exerted on the tracklayer, so it practically is an operation for pulling stumps toward a common center. The tracklayer and engine are strong enough to pull out what few stumps may remain close up to the end of the machine. The tracklayer is also of service in moving on to the next location where the process is repeated.

I have seen that same idea worked out in a little different way with a large steam tractor which was mounted on exceptionally wide wheels to give additional traction. They tied one end of the cable to a large firmly rooted stump, laid it in a sort of arc and then tightened that by moving the tractor forward. As the cable tightened up and straightened out, it tipped over the stumps it came up against and gradually tipped them over until it was entirely straightened and then the cable was thrown to the other side and the process repeated.

Question: Was that after the trees were loosened with dynamite?

Mr. Kline: There is not sufficient force in the cable laid in the arc to tip anything except a well-rotted stump. Hardwood stumps after lying in the ground ten or fifteen years can be tipped over easily.

R. W. Trullinger (Office of Experiment Stations, United States Department of Agriculture, Washington, D.C.): It might be interesting to the members if Mr. Kline could review the work done by the Hercules Powder Company in one of the South Atlantic states recently on the removal of stumps and their distillation.

Mr. Kline: That work was done by Mr. James of our company and was largely experimental, but it was quite largely done for our own interests because, as it proves practical, we shall go into it on a larger scale. Pine stumps, especially those of the South Atlantic states, are very rich in pine tar and turpentine and resin products, so it is profitable to combine the land clearing and distillation processes. That has been gone into largely from a private standpoint. I am not familiar with any of the exact figures in the case, but I do know that a very complete experiment was made to find out the most efficient way of removing these stumps and also the most efficient way in which they could be distilled and the utmost value in the way of pine tar products gotten out. The result has been entirely satisfactory. I have nothing more on that subject except to say that it was a very complete experiment both in the way of removing stumps and in their most profitable distillation.

D. P. Weeks, Jr. (drainage engineer, Dakota Engineering Company, Mitchell, South Dakota): Are there any available costs on that experiment?

Mr. Kline: We have published a booklet on that if anyone cares to have it.

L. F. Livingston (secretary, Marinette County Land Clearing Association, Wausaukee, Wisconsin): I happened to see the Bissell land clearing machine while in operation and Mr. Kline's description was a little faulty in that the figure-eight loop that he explained proved to be an absolute failure. If you can follow the line of a cable as it is being tightened up, you can see that that cable as it is pulled along the side of a stump will be naturally inclined to move up towards the top of the stump and the great majority of stumps were just lifted out of the ground and were not tipped over. Most of the roots were not entirely loosened; therefore, about eighty per cent of the stumps had to be gone after the second time. That idea was thrown aside and the Bissell machine as it stands today has two drums back to back and they use a 1⅛-inch cable running out on each side of the machine. That is hauled out by horse. They use individual chokers which are placed on the stumps by men. Five men are used on the side. The machine draws this cable in to itself. It goes down through a field and leaves a windrow of stumps behind it. The main object of the machine is to clean up, as it goes through, as much land as possible so that the farmer can go in and go to work.

I don't know whether you know it or not, but actual experiment has shown us in the upper part of Wisconsin that from fifty to sixty per cent of the labor of clearing is not removing the stump, but in getting rid of the stump after it is out of the ground. From forty to fifty per cent of the labor and cost puts the stump on top of the ground and from fifty to sixty per cent takes care of it after it is out of the ground. The main idea of the Bissell machine was to leave seventy per cent of the ground entirely free of stumps ready for cultivation after the machine has passed through. The machine costs in the neighborhood of $15,000 and it takes from twelve to sixteen men to operate it. It has not proven practical up to the present time although it is a wonderful advancement beyond anything at present.

I would like to ask you a question, Mr. Kline, in connection with your statement in regard to brushing. Have you any information in connection with windrow brushing as opposed to piling brush?

Mr. Kline: The windrow brushing is the more simple means of getting the brush into one place, but when it comes to burning it isn't as satisfactory as piling. You have to contrast the advantage of less labor of piling your brush against the advantage of much better and more efficient burning.

Mr. Livingston: Do you know of any places where sheep and goats are used, actually and practically used, in cleaning up the brush?

Mr. Kline: It is done very little. It ought to be done but especially in Wisconsin it is not practised at the present time.

Mr. Livingston: I have heard it talked about and have seen newspaper articles on it for the last six years, but I have failed yet to find a place where it has actually been practical to use either sheep or goats as a means of clearing land.

Mr. Kline: Where the sheep and goats are not used, it is necessary to cut the brush and shoots from the stumps with an ax. If they continue to grow, the stumps do not decay at all.

Mr. Livingston: You made the statement that a hardwood stump could be tipped out of the ground readily after it is ten years old. The top of a hardwood stump in our coun-

try when six years old is generally so rotten that it is a dynamite job and not a stump pulling job, because the cable will cut off the top. If it is ten or fifteen years old, a half stick of dynamite will take a fifteen or thirty-inch stump and tip it out.

MR. KLINE: I suggest they be left for a few years in order to let the smaller fibrous roots decay. What do you think of my estimate of the saving to the farmers, Mr. Livingston?

MR. LIVINGSTON: The work was gone over by John Swenehart, professor in charge of land clearing work at the University of Wisconsin. He took our figures and the figures at which dynamite was sold by the retail dealers before we came into the county, and he estimated that the actual saving in cash to the farmers through their quantity buying was $45,000 in the cost of their material alone. For the benefit of those present, I might say that we went in there and had fifty-seven educational meetings in the upper part of the state, in Marinette County, and secured orders for land-clearing material, stump pullers and dynamite, the idea being to group the farmers' orders so we could make carload shipments into the various towns. Each man could take his material out of the car thus saving the cost of rehandling and any interest on the money tied up in the investment. We placed fourteen carloads of dynamite in the county in that way.

On top of that $45,000 saved in the cost of material alone, through our educational meetings one statement was made which I am willing to back up. We estimate through our figures and through what our farmers have told us that the average man using explosive wastes one-third of his material.

MR. KLINE: I have no doubt you are right. Everything in Wisconsin would indicate a large loss in that.

MR. LIVINGSTON: Our aim has been first to get the man his material, and after he has got the material teach him how to use it in the most safe and economical manner. Prof. Swenehart estimates the value of the educational work that we have done in the neighborhood of $100,000.

We have over twelve hundred farmers in our association and the association is financially backed by a twenty-five cent membership fee from each farmer which does not pay for the postage. The rest of the money comes from the bigger interests in the county—newspapers, bankers, and the land companies—and I will say that they have certainly been fine to us. They have not tied any strings to their money. They say, "You get the land cleared and that will advertise our county and will come back in returns to us in other ways." We cleaned up 18,000 acres this last year. That is three times greater than any other quantity of land in any other county in the United States, and it has been done through cooperation all the way through.

JAMES A. KING (Mason City Brick and Tile Company, Mason City, Iowa): What has been the cost per acre?

MR. LIVINGSTON: I don't think there is any such thing as cost per acre. Every acre of stumps is an individual problem by itself. Mr. Kline spoke of the rule of the thumb in connection with the amount of dynamite to put under a stump. He qualified that statement, however, so I will not say anything. Every stump is different from every other stump and every acre of stumps is different from every other acre of stumps. The soil is of different moisture content, so any man who tried to make a statement of the cost of clearing, unless he goes out and goes over that individual acre and counts the stumps and looks them over and sizes up what it is going to cost, cannot tell you what it will cost. There is no such thing as an average cost of clearing the land.

We found that eighty per cent of the dynamite we bought was twenty per cent dynamite.

MR. KLINE: Wasn't that part of your educational campaign?

MR. LIVINGSTON: From an economical standpoint, even though our soil is a light soil, the twenty per cent dynamite, if the soil is damp, will do as good work as forty per cent or thirty per cent dynamite and the saving to the farmer is well worth while.

MR. KLINE: I should have been glad, had I the time and had I not been trying to give an article on the general aspect, to have gone a little further into this Marinette County work. That was very interesting, and Mr. Livingston could have given a very interesting talk on that work up there because it is a practical illustration of the value of large scale land-clearing work carried out through individual settlers.

MR. WEEKS: No doubt many of you have seen the article in a recent issue of the "Engineering News-Record" giving the method of clearing by erecting a pole with a pulley on it and a hoisting drum. After the stump is loosened by dynamite, the hoisting drum draws the stump from its position in the ground and finishes the pulling that the dynamite has not completed, drawing the stump to the pile for burning. The pile may vary in size according to the circumstances. A new pole is erected for each pile and the pole that has been erected is burned with the pile of stumps.

It certainly gives me an inspiration to see the interest shown on the land reclamation subject. I have watched with considerable jealously the development of the American Society of Agricultural Engineers, and I have been afraid at times that the subject of land reclamation, either by land clearing, drainage, or irrigation, would be ground up in the wheels of power machinery or would meet an untimely death in the beater of the threshing machine. I think this is just the beginning of a series of articles on land clearing.

MR. LIVINGSTON: The gentleman who spoke in regard to using a gin pole referred to the same method of stump pulling that is used in the Pacific Northwest entirely. I was raised out there and they use a donkey engine and a gin pole. They have an automatic release on the end of the cable which they hook on to a stump. The stump is pulled in and dropped on top of the pile. The man does not go near the release after he hooks the stump on the end of the cable.

We have tried to apply that to lake state conditions, but the donkey engines are so heavy that there are no stumps in Wisconsin, Michigan, and Minnesota that are big enough to hook on to. What is necessary is a machine which will embody the same principles as the donkey engine of the Pacific Northwest and the tracklaying tractor similar to the Bissell machine. However, the Bissell machine is a different scheme. I think in the near future there will be a machine on the market which will use that same gin pole principle. Because poles are more scarce in this country than they are out in the Pacific Northwest, I think it will be an arrangement made out of structural steel, and the pile will be made underneath the end of it.

WALLACE ASHBY (Meadowlands, Minnesota): The country I am working in is swamp land. It has been drained out. The timber owing to the swampy condition is small timber. Our experience has been that hand work has been more satisfactory than stump pullers or dynamite, although under some conditions we use both. The small trees we have are mostly poplars, spruce, and stuff like that. They grow eight or ten inches in diameter. We take them standing. A gang of men go in and are spread out, a man every ten or fifteen feet, sometimes two men working together. They cut the roots around one side of the tree and then push it over and the tree falling pulls out its own roots. The larger trees have to be cut up. We sometimes cut them up into four and eight-foot lengths, haul off the marketable timber and burn the rest. That is rather a crude and backwoods method and it may be that in the course of time we will get a better method and do it by machinery but up to now we have been using hand labor on the bulk of that work. The trees are small and surface rooted. We have used dynamite and stump pullers where the stumps warranted.

Opportunities for the Agricultural Engineer in Commercial Work

By F. W. Ives

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THE true field of the agricultural engineer is in the improvement of agriculture by means of approved engineering methods. The agricultural engineer must therefore be at once, as the name implies, an engineer and an agriculturist, or at least he must be broadly sympathetic with the farmer and his problems. That he should have a thorough fundamental training in engineering science is conceded at once.

Engineering as applied to agriculture is no different than engineering applied to any other form of endeavor. To be successful in any line the engineer must know his subject; he must be able to analyze his problems and to solve it in all its phases. He must be possessed of enough of the homely virtue of common sense to pick the right solution from among the possibles. Indeed, common sense is as necessary a tool as mathematics.

The nature of farm problems is such that a knowledge of economics is necessary as well as a working knowledge of farm operations. With this background and some experience in the solution of practical problems, the agricultural engineer is in a position to hang out his shingle as a consulting engineer, or to organize a construction company.

The opportunities in the commercial field are many. A brief list follows:

Drainage
Land clearing and development
Farm building construction
Road construction

In the more strictly professional line the following fields are open:

Journalistic
Architect
Consulting engineer
Landscape architect
Irrigation and drainage engineer
Highway engineering
Teaching
Experimental engineering
Research engineering

The field shown in the first group is open and is being worked by contractors, many of whom do not succeed because of a lack of knowledge of farm conditions, a farm viewpoint, or sympathy with the farmer. The farmer being the ultimate consumer in this case must be suited with the goods he buys. Furthermore, the goods delivered to him must be honest, a dollar's worth for a dollar. Too many times the farmer has not been given a square deal, or has felt that he has not had one, so that now he is one of the hardest customers to deal with in real constructive service.

There is room in the farm building field, the drainage field, and the land clearing field for the contractor who really knows agriculture, and who is willing to work for a modest profit. Why do contractors persist in selling the farmer what he does not want or what is cheapest but not best? How many tile drains have been laid that were plowed out the second season? A friend came to me after he had purchased a farm and had done some drainage work. He wanted me to go out with him and see his improvement. I did and upon arriving at the farm found that the drains followed the contour of the land about a foot below the surface, the contractor having naively informed him that the water would siphon out of the hollows.

When the matter was explained to him, he was for bringing suit against the contractor, but the contract the farmer had signed left him without recourse. He now distrusts all contractors, needless to say. This same man is not so hard to convince as to the value of professional services as previously but he still begrudges the money spent for them.

The reward to the contractor who enters the agricultural field will be large if he is honest, willing to work and build up his business on integrity and work well done. "A satisfied customer is the best advertisement" is trite but true. He should insist upon carefully prepared plans and specifications, accurate surveys and estimates that are agreed to by all parties before entering into any contract with a farmer or group of farmers. These plans and estimates should be made by a third and disinterested party. The third party is a referee in case of disagreement and is alike a protection to the contractor and the owner.

The contractor will find that in the long run he cannot afford to prepare plans for work that he is doing. The cost of preparing plans must be paid for somewhere by someone. It is not good practice to bury this cost in the final estimate because it is not fair to the farmer or to architects and engineers in practice. Architects and engineers seldom invite this type of contractor to bid on work prepared by them and with good reason.

The professional field outlined in the second group may be classed collectively as the disinterested third party, and for our purpose may be considered as the professional agricultural engineer. The rewards in this field will not be large and a large share of the compensation will be a knowledge of work well done. It will be impossible at the present time for agricultural engineers engaged in the professional practice as outlined by such agencies as the American Institute of Architects, The American Society of Mechanical Engineers, and others. More likely he will have to do as our physicians, treat the charity patients in the hope that the more wealthy patients will provide the reward. And remember that, like the physician, each case successfully treated adds to one's reputation so that the rewards come later in more substantial commissions based on successful work.

From my own practice and from conversation and correspondence with men engaged in architectural practice in farm buildings, the American farmer is not yet educated to the use of professional service. He still prefers to trust the judgment of the local carpenter and takes the mistakes and discomforts and inconveniences of illy planned buildings as the inevitable result of inelastic materials.

The same man in a well-planned and well-built structure is inclined to marvel at its convenience and comfort and conclude that money did it. It is our business to show him that *planning* and not *money* is what did it.

Paper presented at the Southern Section meeting of the American Society of Agricultural Engineers, at Lexington, Kentucky, February 14, 15 and 16, 1921.

AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

Contributions of interest and value to the agricultural engineering profession are solicited from members of the Society and others. Communications should be addressed to the Editor, Sta. A, Ames, Iowa.

What You Make it

THE good each member of the American Society of Agricultural Engineers gets from his membership in the Society and this includes the benefits to him from the Journal of the Society, AGRICULTURAL ENGINEERING, is derived pretty much in the same way as the good he gets out of his everyday work. The truth of the saying that the good we get out of our work is measured by what we put into it is too obvious to require further explanation. If that statement is accepted as true, therefore, the maximum benefits to be derived from AGRICULTURAL ENGINEERING are a measure of what you put into it.

In other words, the Society has a definite mission and responsibility to perform, that is, the advancement of the science of agricultural engineering and the proper dissemination of agricultural-engineering information. Engineers, perhaps more than people in other walks of life, not excepting the clergy and professional reformers, fully appreciate the duty of the individual human being to contributing his share to leaving the world just a little better than he found it. The members of the Society, therefore, if they accept that line of reasoning, will also acknowledge their duty as members of the Society to do their part in the work of disseminating agricultural-engineering information, and contributing to the advancement of agricultural engineering in a general way to the benefit of the Society and the industries and public which it serves.

Many of the members of the Society have been very generous of their time in preparing technical articles for AGRICULTURAL ENGINEERING of special interest to the membership of the Society, but there is a great need of still further cooperation of the membership as a whole with those responsible for the conduct of the Journal. There will always be a demand for technical articles on the various phases of engineering as applied to agriculture, and, as indicated in a previous paragraph, the benefits which each member receives from the Journal will be largely in proportion to what he contributes to it; this is a fundamental psychological fact which we do not attempt to explain.

While the engineer is constitutionally inclined "to hide his light under a bushel," it is not his purpose to do so because, generally speaking, the engineer has a particularly generous nature. It is simply his environment and the nature of his work which makes him disinclined "to blow his horn from the housetop." Nevertheless, the editorial staff of AGRICULTURAL ENGINEERING needs greatly the cooperation of the members of the Society in putting into this Journal original articles containing the best agricultural-engineering information that it is possible to obtain. And, what is more, there is a wealth of material available which has never been put into circulation, and now is the time to dig it up and each one begin to do his part in helping the Society, through AGRICULTURAL ENGINEERING, to function as we all want and expect it to do.

Members of the Society are requested to furnish the editorial staff with suggestions for articles which they themselves can prepare or suggest authors which are particularly qualified to prepare them. It is also desired that members keep the editorial staff informed of research work that is in progress, as well as other interesting information to agricultural engineers because it is such information that enables us to get in contact with the material that is especially needed.

The Reclamation Section

IN THE February number of AGRICULTURAL ENGINEERING announcement is made of the proposal of David P. Weeks, formerly in charge of drainage work in the agricultural-engineering department of the Iowa State College and now drainage engineer for the Dakota Engineering Company, that a reclamation section of the American Society of Agricultural Engineers be organized. The Council has approved the general plan and the way has been opened for those interested to take the necessary steps to organize such a section.

This step taken to increase the Society's activities in the field of reclamation engineering, which includes principally drainage, irrigation, reforestation and land clearing, is a most significant one. In the years to come, due largely to the fact that new lands in this country have practically all been acquired by private owners, the reclamation of land to increase the production of foodstuff through drainage, irrigation, and clearing will become increasingly important and essential, as will also the reforestation to provide for the timber supply of future generations.

Reclamation is second to none in importance compared with other branches of agricultural engineering, and the farsightedness of the Society in giving recognition to the needs in this direction through the organization of a reclamation section will give encouragement to engineers in this line of work and impetus to the development of this phase of agricultural engineering. The Society in turn will expect the cooperation and support of engineers interested in all phases of reclamation work, not only to make the reclamation section a credit to the American Society of Agricultural Engineers but of highest value to the engineers themselves and indirectly to the public they serve.

In organizing a reclamation section of the American Society of Agricultural Engineers, the purpose is not to usurp the activities or scope of any other engineering or commercial organization. The activities of such a section will seek primarily to develop a closer coordination between the advancement and development of reclamation studies and projects and the requirements of the farming industry. In a large measure, in view of the fact that the Society stands closer to agriculture as an industry than other engineering and commercial organizations, the proposed reclamation section will serve as sort of a connecting link between the reclamation development and activities and strictly farming or agricultural requirements.

A. S. A. E. ACTIVITIES

Committees for 1921

THE result of success obtained by the American Society of Agricultural Engineers during the present year will depend to a very large extent upon the work of the committees. In all instances the chairmen and subchairmen have been consulted in regard to the personnel of the various committees. This fact, together with a rearrangement in our plan of committee organization, has made it impossible to announce these appointments at an earlier date. In some instances committees are still in the process of being formed, but a goodly number are already at work.

MEETINGS COMMITTEE

I. W. Dickerson, Charles City, Iowa, chairman, J. B. Davidson, F. N. G. Kranich, Raymond Olney, and F. A. Wirt.

PUBLICATION COMMITTEE

Raymond Olney, The Power Farming Press, St. Joseph, Michigan, chairman, J. B. Davidson, and F. P. Hanson.

MEMBERSHIP COMMITTEE

Frank P. Hanson, Station A, Ames, Iowa, chairman, J. T. Copeland, L. J. Fletcher, F. N. G. Kranich, David P. Weeks, L. C. Landis, H. M. Lynde and Q. C. Ayres.

COLLEGE SECTION COMMITTEE

F. W. Ives, Ohio State University, Columbus, Ohio, chairman, Wm. Aitkenhead, R. U. Blasingame, J. B. Davidson, S. H. McCrory, E. R. Raney and O. W. Sjogren.

PUBLICITY COMMITTEE

Frank P. Hanson, Station A, Ames, Iowa, chairman, E. J. Baker, Jr., W. B. Jones, and E. H. Lehmann.

POWER FARMING EDUCATIONAL COMMITTEE

F. N. G. Kranich, Hyatt Roller Bearing Co., Chicago, chairman, Wm. Aitkenhead, J. B. Davidson, G. W. McCuen and O. W. Sjogren.

SUBCOMMITTEE

J. Macgregor Smith, Canada; L. J. Fletcher, Pacific Coast; R. U. Blasingame, Eastern; and Mark L. Nichols, Southern.

RESEARCH COMMITTEE

R. W. Trullinger, U. S. Department of Agriculture, Washington, chairman, E. V. Collins, L. J. Fletcher, F. W. Ives, H. W. Riley, Daniels Scoates, O. W. Sjogren, K. J. T. Ekblaw and O. B. Zimmerman.

FARM LIGHTING COMMITTEE

L. L. Keilholtz, Delco Light Company, Dayton, Ohio, chairman, H. M. Beck, C. C. Casgrove, I. W. Dickerson and C. H. Roth.

STANDARDS COMMITTEE

Raymond Olney, The Power Farming Press, St. Joseph, Michigan, chairman, L. L. Keilholtz, David P. Weeks, H. E. Murdock, F. N. G. Kranich, Theo. Brown, L. W. Chase, W. G. Kaiser, J. B. Davidson and G. B. Gunlogson.

ANIMAL MOTORS COMMITTEE

Wayne Dinsmore, Horse Association of America, Union Stock Yards, Chicago, chairman, E. M. D. Bracker, J. T. Montgomery and Ben J. Kough.

IRRIGATION COMMITTEE

H. E. Murdoch, Montana Agricultural College, Bozeman, Montana, chairman.

ROADS COMMITTEE

E. B. McCormick, U. S. Department of Agriculture, Washington, chairman.

DRAINAGE COMMITTEE

D. P. Weeks, Jr., Dakota Engineering Co., Mitchell, South Dakota, chairman, S. H. McCrory, Jas. A. King, R. L. Patty, J. T. Copeland, H. M. Lynde, and H. M. Bliss.

TRACTOR DRAWBAR MACHINERY COMMITTEE

Theo. Brown, Deere & Company, Moline, Illinois, chairman.

SUBCOMMITTEE ON DISK HARROWS

E. V. Collins, Iowa State College, Ames, Iowa, subchairman, C. I. Gunness, A. E. Brandt, C. J. Stirniman, and L. J. Smith.

HORSE DRAWN MACHINERY COMMITTEE

L. W. Chase, Chase-Tinsman Plow Company, Lincoln, Nebraska, chairman.

SUBCOMMITTEE ON LEFT-HAND PLOWS

G. W. McCuen, Ohio State University, Columbus, Ohio, subchairman, C. I. Gunness, R. U. Blasingame, and Wm. Aitkenhead.

FARM STRUCTURES COMMITTEE

W. G. Kaiser, Portland Cement Association, Chicago, chairman.

SUBCOMMITTEE ON VENTILATION

W. B. Clarkson, King Ventilating Company, Owatonna, Minnesota, subchairman, M. A. R. Kelley, J. L. Strahan, L. J. Smith, R. L. Patty, C. S. Whitnah, A. R. Grieg, K. J. T. Ekblaw and R. U. Blasingame.

SUBCOMMITTEE ON FARM STRUCTURE DESIGN

W. A. Foster, Iowa State College, Ames, Iowa, subchairman; F. W. Ives, J. L. Strahan, and F. C. Harris.

SUBCOMMITTEE ON SANITATION

E. W. Lehmann, "Successful Farming," Des Moines, Iowa, subchairman.

SUBCOMMITTEE ON FARM BUILDING EQUIPMENT

F. C. Harris, Louden Machinery Co., Fairfield, Iowa, subchairman.

MECHANICAL MOTORS COMMITTEE

J. B. Davidson, Ames, Iowa, chairman

SUBCOMMITTEE ON STATIONARY GAS ENGINES

E. R. Wiggins, Moline, Illinois, subchairman, L. J. Smith, V.V. Detwiler, and E. B. Sawyer.

SUBCOMMITTEE ON TRACTOR RATINGS

G. W. Iverson, Advance-Rumely Company, La Porte, Indiana, subchairman, K. J. T. Ekblaw, D. L. Arnold, D. P. Davies, F. N. G. Kranich, O. W. Sjogren, L. R. Van Valkenburg, and F. M. White.

SUBCOMMITTEE ON FUELS

A. H. Gilbert, Rock Island Plow Company, Rock Island, Illinois, chairman.

SUBCOMMITTEE ON STATIONARY GAS ENGINES

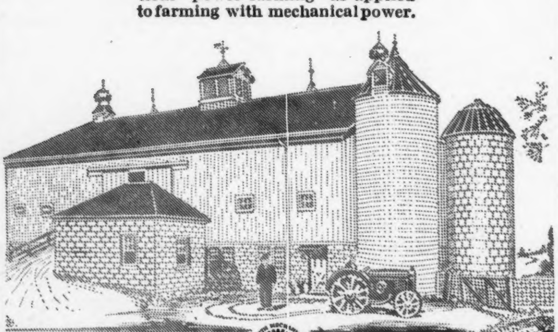
E. R. Wiggins, subchairman, L. J. Smith, V. V. Detwiler, and E. B. Sawyer.

BELT MACHINERY COMMITTEE

G. B. Gunlogson, J. I. Case Threshing Machine Company, Racine, Wisconsin, chairman; A. B. Welty, Chris Nyberg, W. H. Worthington, L. R. Van Volkenburg, J. C. Junken, H. R. Robinson, H. M. Gehl, and J. Leo Ahart.

SUBCOMMITTEE ON THRESHING MACHINES

A. B. Welty, Emerson-Brantingham Implement Company, Rockford, Illinois, subchairman, Chris Nyberg, H. W. Worthington, L. R. Van Valkenburg, and J. C. Junkins.



SUBCOMMITTEE ON SILO FILLERS

Henry M. Gehl, Gehl Bros. Manufacturing Company, West Bend, Wisconsin, subchairman, H. R. Robinson, and J. Leo Ahart.

Good Work of O. S. U. Student Branch

THE attractiveness and the effectiveness of the Society's exhibit at the Columbus Tractor Show were due in large measure to the work done by members of the Ohio State Student Branch. Under the leadership of their president, A. M. Hedge, who was on the job all of the time from beginning to end of the show, the branch members cooperated with the tractor show committee by securing furniture, green plants and in arranging and decorating the booth. It was through their work and responsibility that the charts, photographs, etc., furnished as exhibits by the various agricultural college departments of agricultural engineering were cared for, including taking them down at the close of the show.

Of special value was their assistance to Secretary Frank P. Hanson in acting as a committee on reception and welcome to members and other visitors at the exhibit. The Society is glad to express its thankful appreciation to the Ohio State Student Branch.

Appointment of Tellers

THE following tellers for the ensuing year were recently appointed by President E. A. White: Frank P. Hanson, secretary-treasurer of the Society, chairman; E. M. Mervine, E. V. Collins, and A. W. Clyde.

New Members of the Society

MEMBERS

Carlyle A. Atherton, engineer, National Lamp Works, General Electric Company, Nela Park, Cleveland, Ohio.

Quincy Claude Ayres, assistant professor agricultural engineering, Iowa State College, Ames, Iowa.

A. B. Fridaker, New York Moline Plow Company, Poughkeepsie, New York

Lewis Allen Jones, senior drainage engineer, U. S. Department of Agriculture, Washington, D. C.

Lee H. Kaupke, chief designer, Rock Island Plow Company, Rock Island, Illinois.

George S. Knapp, state irrigation commissioner of Kansas, Topeka, Kansas.

George H. McCray, service engineering department, J. I. Case Threshing Machine Company, Racine, Wisconsin.

Elmer Reynolds Meacham, assistant professor of farm machinery and agronomy, Clemson Agricultural College, Clemson College, South Carolina.

ASSOCIATE MEMBERS

Ray Wilford Carpenter, professor of agricultural engineering, University of Maryland, College Park, Maryland.

Walter J. Taylor, sales engineer, John Lauson Manufacturing Company, New Holstein, Wisconsin.

JUNIOR MEMBERS

Walter A. Kirkpatrick, managing editor, Chilton Tractor Index, and associate editor, Chilton Tractor Journal, Philadelphia, Pennsylvania.

STUDENT BRANCH MEMBERS

Geo. C. Deckler, Iowa State College, Ames, Iowa.

Clark McConnell, University of Wisconsin, Madison Wisconsin.

Robert A. Norton, Iowa State College, Ames, Iowa.

Edward Price, University of Wisconsin, Madison, Wisconsin.

E. G. Schernecker, University of Wisconsin, Madison, Wisconsin.

Applicants for Membership

The following is a list of applicants for membership received since the publication of the February issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send pertinent information relative to the applicants for consideration of the Council prior to their election.

Charles J. Allen, second vice-president, S. L. Allen & Company Inc., Morristown, New Jersey.

Harold Robert Chipman, agricultural engineering specialist, Mississippi A. & M. College, Agricultural College, Mississippi.

Harrison E. Fellows, service superintendent in field work, J. I. Case Threshing Machine Company, Racine, Wisconsin.

Charles A. Francis, tractor roadman, Ford Motor Company, Pittsburg, Pennsylvania.

Frank Wingfield Fuller, advertising manager, Crane & Ordway Company, St. Paul, Minnesota.

Truman Edward Hienton, extension worker, department of agricultural engineering, Ohio State University, Columbus, Ohio.

William Claiborne Howell, instructor tractors and gas engines, Mississippi A. & M. College, Starkville, Mississippi.

Joseph Mader, experimental and designing tractor engineer, S. L. Allen & Company, Philadelphia, Pennsylvania.

Wayland Magee, farmer and manager of Summer Hill Farm, Bennington, Nebraska.

Alfred Mathewson, agricultural representative, E. I. DuPont de Nemours & Company, Wilmington, Delaware.

John Maxwell Meyers, experimental engineer, General Motors Corporation, Pittsburg, Pennsylvania.

Charles W. Pendock, president and general manager, Le Roi Company, Milwaukee, Wisconsin.

Robert Alex Rutherfurd, consulting engineer, Cedarhurst, Long Island.

Jean L. Vincenz, civil and agricultural engineer, Chamberlin & Vincenz, Engineers, Fresno, California.

Herbert Lowe Sohnker, farming, Rock Tavern, New York.

Joseph William Pincus, vice-president, Zionist Society of Engineers, 118 East 28th Street, New York City.

Edwy B. Reid, editor "Farm and Home," Phelps Publishing Company, Chicago.

George Richard Holeton, instructor in farm mechanics, Provincial School of Agriculture, Olds, Alberta, Canada.

(Mrs.) Mary A. Ives, experimental household engineer, Agricultural Engineering Company, Columbus, Ohio.

Richard S. Boonstra, in charge of service schools in Michigan, J. I. Case T. M. Company, East Lansing, Michigan.

A. S. Krotz, chief engineer, implement division, Samson Tractor Company, Janesville, Wisconsin.

Clarence J. Whitacre, chief engineer, tractor and truck division, Samson Tractor Company, Janesville, Wisconsin.

Wayne H. Worthington, chief engineer, Aultman-Taylor Machinery Company, Mansfield, Ohio.